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ABSTRACT

This pilot simulation study examines the important methodological problems involved in costing educational wastage, focusing specifically on the cost implications of educational wastage in primary education. Purpose of the study is to provide a clearer picture of the underlying rationale and interrelated consequences of reducing educational wastage. Although the simulation approach used in the study is experimental, it follows closely the work on the statistical measurement of wastage carried out by UNESCO for the 1970 International Conference on Education. (JG)

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Enquêtes et recherches statistiques : travaux en cours
Current surveys and research in statistics

Costing educational wastage : a pilot simulation study

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION

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PREFACE

It gives me great pleasure to introduce a new series of reports on the current work in progress in the various Divisions of the Office of Statistics of Unesco. The major work of the Office of Statistics is presented formally in the Unesco Statistical Yearbooks, the Statistical Reports and Studies series, the reference documents for ministerial conferences and in other official publications of Unesco and the United Nations. The purpose of this new series is to disseminate, in an informal manner, the results of the current research studies and surveys being undertaken by the Office, without the delays inherent in more formal publications.

It is intended that this series, which will appear in both English and French, will be as wide ranging as is the work of the Office. It will include statistical reviews of selected topics, analytical enquiries, examinations of methodological problems, research studies etc. It reflects a new and exciting stage in the development of the work of the Office, and it is to be hoped that the series will be of considerable interest to persons working in the Unesco subject field as well as to the practising statisticians. We would welcome any comments about the studies as they appear.

STE/1 : PREFACE

This pilot simulation study examines the important methodological problems involved in costing educational wastage which has become one of the most serious educational problems in the world today. It follows very closely upon the work on the statistical measurement of wastage carried out by the Office of Statistics for the 1970 International Conference on Education.

A. INTRODUCTION

1. In most nations of the world the past decade has witnessed a steady and impressive growth of educational efforts. Particularly in developing countries there has been growing awareness of the fact that investment in education is likely to be the key factor of a nation's economic and social development.

Despite many shortcomings, educational statistics vividly reflect this world-wide struggle for more and better education: rates of growth of educational expenditures vastly surmount those of general state budgets. In the majority of countries, their share in National Incomes turns out to be steadily increasing; compulsory schooling periods are being extended, and enrolment ratios rise at almost all levels.

2. It should, however, be clearly recognized that such statistical information indicates inputs into education rather than educational yields. In face of their financial resources being strained to the limit, many governments note a marked disparity between educational efforts on the one hand, and outputs in terms of qualified school leavers and educational attainment of the population on the other. It is this observation which has, consequently, moved the problem of the efficiency of the "educational enterprise" to the focus of current educational research. Both educators and statisticians have come to realize that to a large extent this crucial problem of under-efficiency or educational wastage is due to cumulative repetition and premature leaving of pupils at all levels of the educational system.

3. While pedagogical and sociological research into the causes of repetition and drop-out was certainly not a wholly new thing in the industrialized societies, it became clear, however, that its findings could not be generalized to developing countries. Furthermore, this type of research did not sufficiently serve the need for a suitable methodology of conceptualizing and measuring educational wastage.

Accordingly, a shift of emphasis characterizes more recent work, as compared with the traditional approaches to the problem. *1*

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1 For the methodological aspects, see, among others:

UNESCO: Educacion y economia en Venezuela. Informe de la Mision de planeamiento de la UNESCO (Chipman Report); No. 15, Paris 1963.

P.G. Maes: Méthodes statistiques de mesure du retard et du rendement scolaires. In: Population, 1963, No. 2, p. 359 ff.

W. van Vliet: Les années scolaires perdues. In: Population, 1963, No. 3, p. 531 ff.

D. Blot Les déperditions d'effectifs scolaires; Analyse théorique et application. In: Tiers Monde, No. 22, Tome VI, 1965, p. 492 ff.

Notably, considerable progress has been made along two main lines:

- The box of statistical and conceptual tools has been improved in such a way as to allow for a detailed analysis, country by country, of the incidence and consequences of grade repetition and drop-out at each cycle of the educational process, whereas, until recently, only crude "retention rates", based on year-grade data, could be calculated; The cohort method has been refined; Basic concepts, such as the average number of pupil years invested per successful completer, have been elaborated and applied; Extent and causes of educational wastage in developing countries have, for instance, been subject of a technical seminar convened by UNESCO and ECAFE at Bangkok in 1965. See: *UNESCO: Technical Seminar on Educational Wastage and School Dropouts. II Country Reports and Final Report. Bangkok, UNESCO Regional Office for Education in Asia, 1967.*
  Information on the age distribution of pupils by grade has been collected, and the notion of "median age by grade" introduced.

These examples may show fairly well that the basic requirements for precise and comprehensive diagnosis of educational wastage are now available. 1

- With regard to the above mentioned task of examining the particular patterns of wastage causes in developing countries, a major initial effort has more recently been made. The evaluation of detailed questionnaire replies of some 55 countries allows now for a clearer picture of how the notorious factors intermingle with both economic and social conditions and deficiencies of the teaching-learning process particular to developing countries.

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1 *Cf. the two documents prepared by the Statistical Office of UNESCO for the 32nd Session of the International Conference on Education, Geneva, July 1970:*
a) The Reduction of Educational Wastage (ED/BIE/CONFINTED 32/4)
b) The Statistical Measurement of Educational Wastage (Drop-out, Repetition and School Retardation) (ED/BIE/CONFINTED 32/REF. 1).

4. What conclusions should be drawn from this brief appraisal of the state of the art? Statistics and concepts to assess the extent and profile of educational wastage in a given country are available. The same can be said of the basic insight gained into the specific pattern of wastage causes operating in a particular country. It appears that the basis for designing and planning rational anti-wastage strategies has been laid.

Of course, it cannot be expected that more than a first approach to designing such strategies is presently feasible. Any given measure to combat educational wastage implies a great variety of consequences, their interactions being highly complex. Knowledge of how grade repetition or drop-out might be reduced will by no means be sufficient; consistent planning requires additional insight into the difficult mechanism of consequences, in terms of enrolment changes, prospective numbers of graduates, the way in which unit outlays, annual expenditure totals and, finally, costs per graduate will be affected. A comprehensive examination of this dynamic network of changes is needed.

The present study is a first step in this direction. Its focal point will be on the cost implications of educational wastage in primary education. What savings and what additional cost requirements will a reduction of educational wastage imply, and what does the present wastage situation cost in terms of these alternatives?

It will, however, turn out that answers even to these rather special questions presuppose at least a minimum knowledge of the whole set of monetary as well as non-monetary consequences of wastage reduction.

The simulations approach used in this study will be necessarily experimental, and the answers provided will not be ready for immediate translation into practical policy. But what can be reasonably expected is a clearer picture of the underlying rationale and of the interrelated consequences of reducing educational wastage.

B. BASIC CONCEPTS

I. Educational wastage

1. The economic viewpoint

Education can be analysed from different angles. Pedagogy conceives it as the locus of systematic teaching and learning, sociology focuses on its rôle as an agent of institutionalized socialization processes, law gives emphasis to legal problems of organization and administration of school systems.

The analysis of educational wastage, this term in itself being essentially an economic notion, will, however, apparently profit from an application of economic concepts. We may therefore conceive of education as an institution comparable to some industrial firm: education, as any other industry, receives certain inputs and

applies to these inputs a given production technique, thereby transforming - more or less efficiently - the inputs into outputs. We shall proceed by considering how these elements, namely inputs, outputs and production technique, can be defined for our purposes.

2. Inputs

Precisely speaking, inputs into an educational system are twofold: There are, first of all, the pupils entering a given system or cycle; secondly, there are different kinds of educational supplies and services - teachers, textbooks, classroom equipment, school buildings, social services, school transport etc. - which will be spent on those new entrants in the course of their school career. In order to arrive at an adequate and concise statistical expression for these two input components, we may define as inputs into a given educational cycle the number of pupils entering the cycle, multiplied by the number of school years which each of them actually spends in the cycle. Inputs are thus measured in "pupil years". Any one pupil year stands for both a pupil's personal efforts and the educational supplies and services spent on him in the course of one school year.

3. Output

Educational output is basically to be defined as the number of pupils successfully leaving an educational cycle. If we wish, however, to apply this general definition, everything depends on the meaning given to "success" in school. If one contends that only completion of the full cycle represents a success both for the individual and for society, then, of course, only graduates will be defined as educational output. However, supporters of the alternative definition argue that every partial period of schooling adds to the attainment of a pupil and can, therefore, be regarded as some partial "success". They take over, in other words, the economic distinction between intermediary and final output, ascribing some value also to the former. Technically speaking, this definitional approach " . . . takes a successful graduate as one, and dropouts as less than one, the fraction getting smaller the earlier the dropout occurs." 1

This definition has, for instance, been used by CHICKERMANE in his study of educational wastage in India. 2

Without dwelling on these definitional alternatives, we may observe that it is obviously different conceptions of the learning process which are at the heart of the matter.

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1 *Cf. G. WILSON/P. LEWIS: Cost Studies in Higher Education. In: Higher Education Review, Vol. 2, No. 2, Spring 1970, p. 23.*

2 *Cf. D.V. CHICKERMANE: A Study of Wastage in Primary Education in India. In: Education and Psychology Review, Vol. 2, Jan. 1962, pp. 19-23.*

- On the one hand, there is the argument that the total learning process is composed of indivisible phases, and that full accomplishment of these phases or cycles is necessary. The often quoted case of "lapse into illiteracy" after less than the prescribed length of primary schooling does, in fact, support this position.
- On the other hand, there is the concept of incremental gains in learning outcomes; it is argued that any division into phases or cycles is more or less arbitrary and that basic socialization and mental development of a child will benefit even from two or three years of schooling. This concept seems to apply notably to secondary education, where pupils have already completed the primary cycle.

For the purpose of this study which relates primarily to elementary schooling in developing countries, the first definition will be adopted. Only successful completers of the full cycle will be regarded as educational output. 3

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3 *However, on pp. 31 ff. of this study we shall present a variant of our simulations which accounts for intermediary output as well. This will allow for comparisons between the two definitional alternatives.*

It may be worth mentioning that these are real, not monetary outputs. No attempt will be made here to investigate what the monetary equivalent of this real output - in terms of a graduate's lifetime earnings or the social spillover benefits due to his qualification - might be. Such an analysis which would certainly be indispensable in the framework of a more comprehensive comparison of costs and external, societal benefits of education, would lead us too far.

4. The educational "production technique"

In educational systems, as in any other industry, the degree of efficiency and/or the incidence of wastage can only be assessed if we know what their production technique is. This self-explanatory statement is, unfortunately, not always fully allowed for.

The production technique of education may be said to consist of formal regulations with regard to :

- formal length of cycles, i.e: number of grades
- compulsory or voluntary attendance
- grade pass requirements
- number of repetitions permitted
- etc.

While the degree of wastage in two educational systems with very similar production techniques can certainly be compared, this is far more difficult in the case of two systems where one for instance has introduced automatic promotion while the other has maintained yearly grade pass examinations.

To avoid this kind of conceptual problem, our analyses of the implications of different anti-wastage strategies will always be based on the assumption of a given production technique which allows for both grade repetition and drop-out.

5. The wastage ratio

With these definitions in mind, we shall now establish a precise index for the measurement of educational wastage.

First of all, an optimum relation between inputs and outputs can be defined, namely :

$$R\ opt. = \frac{O \times t_n}{O}$$

where O stands for graduates, and t_n denotes the formal duration of an educational cycle. This relation will be termed the "efficiency relation".

Against the "efficiency relation", the input-output relation actually effected in the respective cycle can be measured. This relation, which we shall term the "actual relation", is equal to :

$$R\ act. = \frac{O \times t_n + R \times 1 + \sum_{1}^{t_{n-1}} D_{t_i} \times t_i}{O}$$

O, R and D are graduates, repeaters and drop-outs, t_n is again the formal duration of the cycle, and $i = 1, \ldots t_n$. It can be seen that the numerator of the "actual relation", as opposed to the "efficiency relation", comprises additional pupil years spent by repeaters and drop-outs. In the case of repeaters, these additional inputs can be calculated by simply adding up all cases of repetition occurring during the progression of a given cohort through the cycle. To arrive at the additional pupil years spent by drop-outs, all observed drop-outs have to be multiplied with the number of grades after which they occur.

The wastage ratio, now, can be expressed as the ratio between the "actual" and the "efficiency relation" :

$$W = \frac{R\ act.}{R\ opt.}$$

10

$$W = \frac{0 \times t_n + R \times 1 + \sum_{1}^{t_n-1} D_{t_i} \times t_i}{0} : \frac{0 \times t_n}{0}$$

$$W = 1 + \frac{R \times 1 + \sum_{1}^{t_n-1} D_{t_i} \times t_i}{0 \times t_n}$$

While this wastage ratio relates two different input-output ratios, it is in itself rather an "input-input ratio", expressing the actual input invested as a percentage of the optimum input. W is defined within the limits $+ 1 \leq W \leq \infty$.

Apparently, educational wastage will be nil if the number of pupil years spent by repeaters and drop-outs is zero. In that case, W will be at its optimum value of + 1. The wastage ratio will then be identical with what may be termed the "coefficient of efficiency" which, by definition, is equal to $\frac{1}{W}$.

6. Limitations of analysis

As with all scientific research, a framework of well-defined concepts is necessary for unambiguous treatment of the problems involved, but, at the same time, it limits the coverage of analysis. A few remarks on the problems excluded by our definitions may therefore be in order:

First of all, wastage is being discussed here in terms of internal under-efficiency of a given educational cycle. This means that the study of educational wastage in terms of external maladaptation of education to economy and society is principally excluded from our analysis. Even with an optimum internal efficiency, educational systems are often badly adapted to the needs of society both in quantitative and qualitative respect. New entrants into the system may represent too small a fraction of a nation's pool of ability, and the educational system may produce not enough - or too many - graduates with the wrong qualifications. These cases of external maladjustment also imply a considerable waste of human and financial resources. Research into these problems will be required to complement the study of internal underefficiency in education.

Secondly, as we have stated above, our concept of educational wastage is, by its very definition, linked to the existence of grade repetition regulations and drop-out in an educational system. Consequently, its usefulness is restricted to the study of school systems which employ this particular, though very common, educational "production technique". This is a point which should be seen very clearly. If we would attempt to apply our concept of wastage to school systems with automatic promotion and strictly ensured compulsory attendance, this would give an optimum value of + 1 for the wastage ratio, and such a system would seemingly show a perfect internal efficiency.

The solution to this paradox is, of course, that our concept of wastage is not adequate to measure internal underefficiency in such cases. In a wider sense, there is certainly still wastage; but it can no more be conceived of and measured in terms of repeaters and drop-outs; instead, wastage then expresses itself through latent under-attainment, which is extremely difficult to trace and measure statistically. Higher education, for instance, is a field where this problem of identifying the nature and extent of wastage is quite obvious. [1] New methods will therefore have to be developed to cover this and related problem areas.

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1 For a discussion of the various difficulties of recording and locating wastage in higher education, see: UNESCO, The Reduction of Educational Wastage, op.cit., pp. 39-42.

II. Costs of wastage

1. Costs per graduate vz. annual costs

Now that both our concept of wastage and its limitations are clarified, it is necessary to focus on the cost aspects of the problem.

To begin with, it appears that wastage is linked to educational costs or expenditures [2] in a double respect

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2 Throughout this study, no distinction will be made between costs and expenditure. We shall speak of costs although the available statistics refer to actual expenditures or even budgetary figures in practically all cases. It would seem that the numerical difference, though not the conceptual distinction between both concepts, will on the whole turn out to be negligible.

- First of all, educational wastage will obviously influence total costs per graduate. This is the monetary equivalent of all educational supplies and services which have to be spent in a school system through a series of years and which will finally yield on the average one successful graduate. The higher wastage, the higher will be total costs per graduate.
- Secondly, educational wastage is related to total annual costs of education, both per pupil and in absolute terms. For the extent of repetition and drop-out will, on the one hand, presumably be reflected in the costs of educational supplies and services spent per pupil in a given school year, on the other hand, the very number of pupils in this year will depend on the degree of repetition and drop-out.

Clearly, wastage is positively related to costs per graduate. But it is less clear, what the relationship between wastage and annual costs looks like. Here, the connection cannot be expected to be positive in any case. We may take, for instance, a country where wastage increases exclusively through additional school drop-out; in that case, the increase in wastage would be followed by a lowering of pupil numbers and, hence, lower absolute annual costs. [3]

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3 This is of course valid only under the premise that the effect of school drop-out is not compensated by a sharp increase of new entrants, and that annual unit costs per pupil remain the same.

The effects of increasing or decreasing educational wastage on costs per graduate and annual costs are therefore not necessarily congruent. It may be that, say, a reduction of wastage will lower the costs per graduate, raising at the same time annual costs.

Which of these two cost concepts is given emphasis seems to be primarily a question of political priorities. In certain budgetary bottleneck situations a country may well prefer to treat the wastage problem in such a way that its present capacity of financing education will not be overdrawn, or that annual costs of education will even be lowered. The objective of having favourable costs per graduate will then temporarily move to the background.

As a rule, however, the lowering of costs per graduate can be supposed to be the primary objective. In that case, educational policy-makers think in terms of cost-benefit relations rather than in terms of absolute costs. In the second place only, the effects on annual costs will be taken into account. The limited capacity of annual educational budgets must always be considered as a constraint on anti-wastage strategies attempting to minimize costs per graduate.

2. Costs as a differential

We have pointed out which cost concepts are principally involved in considering educational wastage. Yet it may be useful to go somewhat deeper into the problem. There seems to be still some vagueness as to exactly what we mean when we speak of "costs of wastage".

To answer this question, it is helpful to re-examine the concept of wastage itself, as it has been defined by means of the "wastage ratio W". By its very construction, the wastage ratio refers to a differential between two different situations: the observed situation on the one hand, characterized by a certain pattern of repetition and drop-out, and measured through the "actual relation R act."; an ideal situation on the other hand, in which neither repetition nor drop-out occurs, its statistical indication being the "efficiency relation R opt.". Technically speaking, the wastage ratio gives the differential between the real inputs actually incurred and those inputs that would be required in an ideal situation.

Similarly, to speak of "costs of wastage" makes sense only insofar as the costs actually incurred in an educational system are being implicitly compared with those costs that would be required in a better situation with less or no wastage. This holds regardless of whether one refers to annual costs or costs per graduate. It would be perfectly meaningless to try to assess costs of wastage per se. From this, we may conclude that costs of wastage can be ascertained and calculated only if we have a sufficiently clear picture of the cost implications of that "reference situation" which we are considering.

This postulate poses a new problem: while the available concepts allow for a detailed analysis of the actual wastage situation, including its costs aspects, they are, on the other hand, not fully adequate to unveil the cost implications of the reference situation. They do not tell us the amount of annual costs (or costs per graduate) required, if there were no wastage or if we had at least succeeded in eliminating, say, repetition of the terminal grade. It is this kind of information, however, which is needed in order to know the differential costs of the wastage actually observed.

There is, however, an additional problem severely complicating the task: if we confront the costs of the actual situation to the presumably lower costs of a more favourable situation, then we must also account for those costs required to get from here to there.

To give a simple example: let us assume a country where overall repetition rates are very high (situation A, r = 50%); let annual costs per pupil in this situation be 100, and costs per graduate 600. Now this country may consider a marked reduction of repetition rates (reference situation B, r = 25%). To accomplish this, certain measures will have to be taken. If the necessary measures would not produce additional costs, then an expert might calculate annual costs per pupil in situation B to be still 100, costs per graduate decreasing to, say, 400. In terms of costs per graduate, then, the differential cost of wastage would be 600 - 400 = 200. However, it must be expected that transition from situation A to situation B will be highly costly. If the same expert had the respective cost requirements available, he might well be led to calculate that annual costs per pupil in situation B would increase to 150, costs per graduate slightly decreasing to 550. In terms of costs per graduate,

the differential cost of wastage would now only be 600 - 550 = 50, while in terms of annual costs per pupil the differential cost of wastage would even be negative (100 - 150 = -50).
It is the additional "costs of transition", therefore, which play an important rôle in calculating the differential costs of wastage. If they are neglected, the exercise will be rather irrelevant.

Let us now see what the conventional approach to calculating costs of wastage is, and what assumptions with regard to the reference situation and to the costs of transition it implies.

C. THE CONVENTIONAL APPROACH

I. An example

1. Although current research has primarily focused on measuring the actual incidence of educational wastage, there have also been some attempts to calculate the financial costs involved. The basic rationale of these calculations appears to be largely the same in all cases. We shall therefore restrict ourselves to picking out one example.

2. The various reports presented to the UNESCO/ECAFE 'Technical Seminar on Educational Wastage and School Dropouts' in 1965 revealed, for the first time, the overall magnitude of the wastage problem in Asian countries, and allowed for an assessment of the costs involved. The technique and assumptions used for these financial calculations are summarized in the March 1967 issue of the Bulletin of the UNESCO Regional Office for Education in Asia. [1] We may refer to the case of Iran to illustrate the logic of this approach :

[1] *Cf. Bulletin of the UNESCO Regional Office for Education in Asia, Vol. I, No. 2, March 1967, pp. 30-34.*

a) According to data furnished by national authorities, enrolment in the terminal grade of primary education in 1964 was some 206,000. This was taken as a rough measure of graduates or output in this cycle.
b) Making use of simple year-grade data and without any distinction between repeaters and drop-outs, the number of pupil years actually invested per unit of output was calculated as 7.5. This was multiplied with the 1961/1965 average of annual unit costs in public primary education, thereby arriving at 7.5 x 3000 = 22,500 actual costs per graduate, measured in local currency.
c) Costs of wastage being a differential between the actual situation and a - more favourable - reference situation, the latter had to be defined. The authors therefore decided to refer to a situation in which primary school enrolment was restricted, from the outset, to those 206,000 pupils who actually arrived, without dropping out or repeating, at the terminal grade in the minimum number of 6 school years. In a strict sense, this seemed to be an ideal in which no wastage occurred, the number of pupil years invested per unit of output being reduced to the prescribed minimum of 6.0.
d) The cost implications of the reference situation were calculated by multiplying the ideal number of pupil years per unit of output with the same 1961/1965 average of annual unit costs, namely 6.0 x 3,000 = 18,000. Optimum costs per graduate, in other words, were assumed to be 18,000. Additional costs of transition to such a situation were not taken into account.
e) On this basis, costs of wastage were expressed as the difference between actual and optimum costs per graduate: they were found to be 22,500 - 18,000 = 4,500 rial per graduate. As there were 206,000 graduates, the corresponding total costs of wastage were estimated as 206,000 x 4,500 = 927 millions of rials.

3. It is interesting to note that two closely related interpretations of this type of "costs of wastage" figures have been put forward :
   a) On the one hand, the 927 millions of rials were interpreted in terms of absolute savings: From the funds actually spent in the course of those average 7.5 school years needed to produce a graduate, 927 millions of rials could have been saved, if there had been no wastage.
   b) Alternatively, the same figure was interpreted in terms of additional outputs rather than a reduction of educational budgets: Suppose the 927 millions of rials actually spent on repeater and drop-out years had from the outset been allocated to prospective graduates. Then, without either saving or increasing the funds that were actually spent, an additional 927 millions : 18,000 = 51,500 graduates could have been produced. This would imply an increase in output of 25% (compared with the observed output of 206,000 pupils), without any increase in educational budgets.

   Both interpretations of "costs of wastage" should be seen as two sides of the same coin. They differ according to whether political priority is given to a reduction of educational budgets (case a) or to increasing the number of graduates (case b). In both cases, however, it is the underlying assumptions concerning the reference situation and costs of transition, which determine the value of such cost estimates. Hence we have to consider these assumptions in more detail.

II. Critical comments

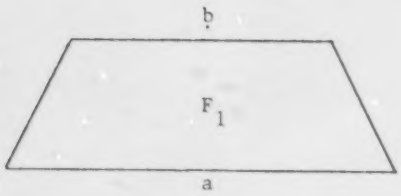
The conventional approach to the problem of costing educational wastage can be commented upon along the following lines:

1. First of all, the calculations for which we have given an example suffer from a number of serious data deficiencies: pupils in the terminal grade are certainly not a satisfactory measure of educational output; simple year-grade data which do not distinguish between repeaters and drop-outs allow, of course, only for a very crude reconstruction of the actual flow of a cohort rhrough an educational cycle; using a global five-year average of unit costs to calculate costs of wastage which, of course, occurs at different grades, is also not very satisfactory.

   But these are minor shortcomings. It appears that even with better statistical data there would still remain a basic weakness of the conventional approach, namely its apparent abstractness and irrelevance, compared with the actual problems of an anti-wastage policy.

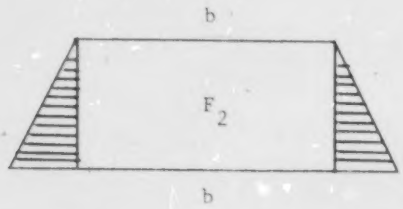
2. In reality, a situation in which no educational wastage whatsoever occurs is completely beyond any practical possibilities, especially for developing countries. Therefore it doesn't make much sense to calculate costs of wastage by confronting reality with an abstract ideal alternative. Instead, it would seem reasonable to consider a "reference situation" where certain improvements with regard to educational wastage have been realized, and to compare the cost implications of that situation with those actually incurred. Cost calculations should, to put it bluntly, correspond to realistic planning rather than wishful thinking.

3. There are, moreover, good reasons to question whether the "ideal" situation which the conventional approach refers to, is on the whole a desirable target. For, as we have seen, it implies eliminating, from the very start of the schooling process, those who would otherwise repeat or drop out. Those who have used the conventional approach to calculating costs of wastage have not given due attention to the fact that implementing such a situation would inevitably result in a very restrictive and conservative educational policy. This becomes clear by recalling that both variants of the conventional approach imply a more or less drastic selection among new entrants into the school system :
   a) The impact of wastage on a cohort flowing through a given educational cycle may be roughly illustrated by means of a "cohort retention pyramid"



where "a" is the actual number of new entrants and "b" the observed number of graduates, the area "F_1" of the pyramid being equal to the number of pupil years invested (real input).

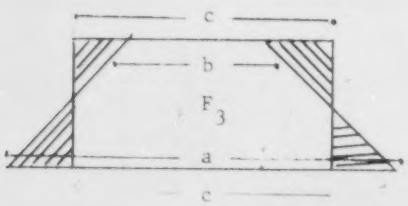
b) Now, the first variant of the conventional approach focuses on saving the costs of wastage in absolute terms. Accordingly, it proposes to restrict the total of new entrants "a" to a sub-population "b" which equals the actual output "b" some years later :



$F_2 < F_1$

Obviously, in that case there would be no wastage, and the pupil years corresponding to the hatched sub-areas of the pyramid could be saved ($F_2 < F_1$).

c) Similarly, the second variant, focusing on additional outputs rather than budgetary savings, would presume that from the total of new entrants "a" a sub-population "c" be selected; as by definition there would be neither repetition nor drop-out, output at the end of the cycle would also be "c", i.e. larger than the actual output "b" :



$F_3 = F_1$

The exact size of "c" would be determined by postulating that the area F_3 of the rectangle be equal to the area F_1 of the actual pyramid. In other words, through mere reallocation of the pupil years actually invested, an additional output of size (c - b) could be obtained.

d) It need not be recalled, however, that the idea of reducing entrants cohorts in order to "save" the money otherwise spent on repeater years and potential drop-outs is contrary to the guiding principle of education as a human right, to compulsory education acts and to the need of developing countries for more and better qualified human resources. Moreover, restrictive school admission implies mere shifting rather than a solution of the wastage problem: in trying to reduce wastage within the school one would incur a tremendous waste of talent and motivation at the beginning of the educational cycle.

To summarize our argument, we conclude that the conventional approach to costing educational wastage lacks practical relevance because it considers a reference situation which is neither realistic nor politically desirable.

4. Finally, the conventional approach neglects what we called "costs of transition" from the actual to the reference situation. Annual unit costs, as we have seen, are assumed to remain unaltered, although repetition and drop-out have presumably been reduced to zero. This is tantamount to saying that educational wastage can be remedied without improving the quantity and quality of teachers, instructional materials, social services and buildings per pupil.

Research into the causes of educational wastage has, however, shown vividly that complex and to a large extent highly expensive measures will be needed to reduce repetition and drop-out. Whether there are also effective measures which are less costly is a problem deserving thorough scrutiny. As a general rule, one will have to start from the proposition that average costs per pupil are likely to increase with any major attempt to combat educational wastage. Exactly to what extent and under what conditions they will have to be raised is extremely difficult to anticipate. In fact, this question lies at the heart of the whole problem of calculating differential costs of wastage. The ceteris paribus assumption with regard to annual unit costs per pupil, on which the rationale of the conventional approach is based, has a priori excluded this problem from the discussion.

III. Conclusions

What conclusions can be drawn from this criticism of the conventional approach? Along what lines should the basic assumptions be improved?

Some indications as to necessary further steps have been outlined in a background report to the above-mentioned Technical Seminar :

" ... It would seem that the next step of a financial analysis would be to consider the possible cost of remedial measures, which could lead to a cost/benefit analysis. It would be interesting to see whether such analysis would not show from the point of view of the 'productivity of the educational industry', that a relatively small additional input might produce substantial returns, in other words, that measures to reduce wastage might also reduce the unit cost of the final product (a graduate or a literate child). On the other hand, the cost per student enrolled and per year would be normally increased by such measures, as well as overall enrolment, so that the financial implications would have to be seen also from the point of view of the capacity of national budgets to finance such measures." [1]

[1] Cf. *"School Wastage in the Asian Region. Quantitative Aspects and Financial Implications", Report presented to The Technical Seminar on Educational Wastage and School Dropouts, Bangkok 1966 (unpublished manuscript).*

It is, in fact, this kind of consideration which is essential for a more feasible and operational approach to the problem of costing educational wastage. Much more effort must be dedicated to examining cost implications of alternative wastage situations and of the action leading towards such situations.

It is simulative analysis, therefore, which is called for, tracing in a dynamic way the various interrelated implications of remedial action.

This postulate indicates the lines along which we shall proceed in the following chapter of the study.

In contrast to the conventional approach, the basic assumptions will be chosen to enable an operational analysis, corresponding to the real task of planning for wastage reduction:

- Instead of contrasting reality with an abstract ideal, the actual sequence of gradually reducing educational wastage over successive years will be examined.
- In the place of artificially curtailing entrance cohorts, the inflow of pupils into the school system will be taken as an exogenous variable.
- Instead of subjecting annual unit costs to a rigid ceteris paribus clause, possible costs of transition which arise from the process of reducing wastage will be thoroughly discussed.

The analysis itself will suitably be divided into three stages :

- As a first stage, the effect of a stepwise reduction of educational wastage on inputs (pupil years invested) and outputs (graduates) will be examined by means of partial numerical simulations. These "non-monetary" relationships form the basic prerequisite for a subsequent analysis of cost implications.
- In a second stage, the analysis will have to focus on possible relationships between annual unit costs per pupil on the one hand, and the reduction of educational wastage. This appears to be by far the most difficult part of the exercise, to which no simple straightforward solutions can be given.
- In a third stage, the findings of the two preceding steps of analysis will be combined in a set of comprehensive "simulation tables". These tables will allow one to identify, though on a rather general level, the complex consequences and notably cost implications of wastage reduction.

D. A DYNAMIC APPROACH: SIMULATING THE IMPLICATIONS OF WASTAGE REDUCTION

I. Simulating enrolment and output effects

1. A simple simulation model

For the study of cost implications of reducing educational wastage it appears imperative to discuss, in a first stage, the problem in non-monetary terms. In this paragraph, we shall therefore focus on the impact of wastage reduction both on real inputs into an educational cycle, measured in terms of pupil years invested, and educational outputs, i.e. graduates.
According to the definition given above [1], wastage exists if actual inputs are higher than they would be under optimum conditions, due to additional school years spent by repeaters and drop-outs.

[1] Cf. pp. 7 et seq.

For both analytical and practical reasons, these two components of educational wastage must be clearly distinguished. As a working hypothesis, it can be assumed that with regard to induced changes in real inputs and output a reduction of either repetition or drop-out rates will not work in the same direction.

To test this hypothesis we shall set up a simple simulation model :

Let us assume a fictitious cohort of 1.000 new entrants proceeding through an elementary cycle. The cycle is assumed to consist of four grades. The educational "production technique" is such that both grade repetition and drop-out are institutionally possible, the number of repetitions permitted being unlimited. Total real input will then consist of all those pupil years which the 1.000 new entrants need to complete the cycle and/or leave it prematurely. Total output is defined as comprising all pupils leaving after completion of the fourth grade; this may occur immediately after four years, or later, if a graduate has previously repeated once or more. We further assume a global repetition rate "r" which is constant over all grades and school years respectively; similarly, we assume a constant drop-out rate "d". These latter assumptions are of course very crude, and we shall modify them in a later stage. 1

1 *Cf. pp. 26 ff. below.*

Repetition and drop-out rates will be treated as instrumental variables of our simple simulation model. The dependent variables, on the other hand, are total real inputs and output. We shall, in other words, study the effects of changing repetition and drop-out rates in terms of pupil years invested and graduates produced.

Now, we may distinguish between three alternative strategies of manipulating the instrumental variables, the effects of which will be simulated separately :

- strategy 1: reducing drop-out rates, holding repetition rates constant.
- strategy 2: reducing repetition rates, holding drop-out rates constant.
- strategy 3: joint reduction of both drop-out and repetition rates.

1.1 The pure strategy: reducing drop-out

In the framework of our simple simulation model the relationships between instrumental variables on the one hand, and dependent variables on the other are algebraically determined. For any given reduction of drop-out rates, therefore, the corresponding changes in total input and output can be predicted. 2

2 *An algebraic treatment of the respective relationships will be given in Annex I to this study.*

We may now start from a fictitious "status quo" of wastage incidence in a given country; in view of the actual situation of primary education in many developing countries, let the overall repetition rate by r = 30% and the drop-out rate d = 5%.

The following table then demonstrates how alternative "pure strategies" of reducing drop-out rates, holding the repetition rate constant, will affect total real inputs and output respectively. For any given reduction of "d", the table also specifies the corresponding "actual relation", the "efficiency relation" and the "wastage ratio W". 3

3 *For definitions of these concepts, cf. above pp.8 - 9.*

Simulation table 1

	r	d	Total real input	in %	Output	in %	Actual relation	Efficiency relation	W
Status Quo	30	5	5,134	100	803	100	6.39	4.0	1.60
Alternative Strategies	30	4	5,245	102	841	105	6.23	4.0	1.56
	30	3	5,359	104	878	109	6.10	4.0	1.52
	30	2	5,473	107	917	114	5.97	4.0	1.49
	30	1	5,592	109	958	119	5.84	4.0	1.46
	30	0	5,712	111	1 000	124	5.71	4.0	1.43

It can be seen that the pure strategy of reducing drop-out rates which we are considering will increase the necessary total real input; while initially our cohort spent 5,134 pupil years in the cycle, it will spend 5,712 pupil years, if drop-out rates have been reduced to zero, repetition rates being unaltered.

On the other hand, the corresponding increase in output will be more than proportionate; with a stepwise reduction of drop-out rates from 5% to zero, output will be raised by 24%, as compared with only 11% increase in inputs. Apparently, this will result in a lowering of the "actual relation" from 6.39 to 5.71 and an amelioration of the "wastage ratio W", which will fall from 1.60 to 1.43.

Of course, no straightforward political conclusions can be drawn from these theoretical simulations. But it may be expected that, on the whole, the internal efficiency of educational systems can be perceptibly improved if governments manage to reduce drop-out rates, even if the problem of grade repetition is not being solved.

However, our simulations also suggest that the very reduction of drop-out rates, although leading to better internal efficiency, is likely to increase absolute enrolment; those who might have dropped out otherwise will now remain in school, and additional supplies and services will be required for them. In certain cases, this may act as a constraint on long-term programmes to reduce drop-out, the principal objective of improving internal efficiency then being disregarded due to limited financial capacities.

1.2 The pure strategy: reducing repetition

Still in the framework of our simple model, we may now examine another "pure strategy", namely that of reducing repetition rates, holding the overall drop-out rate constant.

Let us again start from the fictitious "status quo" of the wastage problem, characterized by an overall repetition rate of r = 30% and a drop-out rate d = 5%. We are interested to know the consequences in terms of total real input and output of alternative reductions of repetition rates. The following table gives the results of our theoretical simulations:

Simulation table 2

	r	d	Total real input	in %	Output	in %	Actual relation	Efficiency relation	W
Status Quo	30	5	5,134	100	803	100	6.39	4.0	1.60
Alternative Strategies	25	5	4,822	93.9	815	101.5	5.91	4.0	1.48
	20	5	4,548	88.6	825	102.7	5.51	4.0	1.38
	15	5	4,306	83.9	834	103.9	5.16	4.0	1.29
	10	5	4,087	79.6	842	104.9	4.85	4.0	1.21
	5	5	3,890	75.8	850	105.9	4.58	4.0	1.15
	0	5	3,710	72.3	857	106.7	4.33	4.0	1.08

Contrary to the preceding case where we analysed the implications of reducing drop-out, this second type of a "pure strategy" induces a marked reduction of total real input; while initially 5,134 pupil years had to be invested, only 4,306 pupil years will be required if the repetition rate is reduced to r = 15%, and only 3,710 if we manage to abolish repetition completely. This will happen even with an unaltered overall drop-out rate of d = 5%.

At the same time, we observe a noticeable, though not very marked, increase of output; this latter result of our simulations is, in fact, of special interest: it suggests modifying the common assumption that educational output is solely a function of drop-out rates, independent of the degree of repetition.

Both tendencies, if taken together, result in a considerable improvement of the "actual relation" and, consequently, of the "wastage ratio W": the "actual relation" will fall from 6.39 to 4.33 pupil years per unit of output; compared with its initial value of W = 1.60, the wastage ratio will move strongly towards its optimum value of W = 1.00.

Again, caveats against rash political interpretation of these findings seem indicated. At the first glance, the pure strategy of reducing repetition rates seems to be highly efficient and recommendable: according to our theoretical simulations, improvements both in absolute terms - absolutely less pupil years will have to be invested - and in terms of internal efficiency, as evidenced by a marked decrease of the wastage ratio, can be expected.

However, it seems rather unlikely that this type of strategy will ever be implemented in its pure form. Actually, there appears to be a strong link between repetition and drop-out: Children who have repeated one or several grades are also likely to drop out, as they may have become too old for the grade in which they are placed, or because their parents find further schooling useless and too expensive. Thus, repetition appears to be a major cause of drop-out, though certainly not the only one. 1 It is, therefore, not very realistic to assume "pure" changes in repetition rates which would not affect drop-out rates at the same time. As both phenomena are strongly connected with each other, it is much more interesting from the point of view of practical relevance to simulate "mixed strategies" where both repetition and drop-out rates vary jointly.

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1 *Little is known about the precise nature of the relationship between repetition and drop-out. Future research should include correlational analysis on a cross-section basis to clarify this point. The practical application would be that our efforts to reduce wastage could focus on repetition, thereby indirectly reducing drop-out as well.*

1.3 Mixed strategies

From the preceding simulations of the two "pure strategies" we can conclude that reductions of repetition rates will lower the required amount of real input, whereas a reduction of drop-out rates works in the opposite direction. It can be concluded that the net impact of a simultaneous reduction of both repetition and drop-out rates will depend on the numerical ratio between the respective reduction rates. Considerable reductions of drop-out rates together with only a slight lowering of repetition rates are likely to increase necessary total real input, and vice versa.

To illustrate these relationships more clearly we shall simulate three alternative "mixed strategies". Each of them will again start from the fictitious "status quo" of the wastage problem, i.e. from an overall repetition rate r = 30% and a drop-out rate d = 5%. Yet these sub-strategies differ according to the relative weight given to the reduction of the two wastage components in each specific case.

weight given to the reduction of the two wastage components in each specific case.

For the first sub-strategy, the relative reduction of drop-out rates is apparently much higher than the relative reduction of repetition rates, lowering "d" from 5.0% to 4.0% implies a 20% reduction, while lowering "r" from 30.0% to 29.0% leads to a reduction of some 3.3% only.

Consequently, the expanding impact on total real input of reducing drop-out rates dominates the picture: The total pupil years spent by our cohort will slightly increase. However, the corresponding output growth turns out to be more than proportionate, so that moderate improvements of the "actual relation" and of the wastage ratio W can be expected.

The second sub-strategy implies a much faster reduction of repetition rates, as compared with the sub-strategy considered above. In fact, repetition rates are assumed to be reduced at a pace almost equal to the relative reduction of drop-out rates. Under these conditions, the "shrinking" effect of lowering repetition will predominate: Total real input decreases by 18%. On the other hand, output increases at the same time by 24.5 percentage points; the "actual relation" will therefore be considerably improved, and the wastage ratio approaches its optimum value.

The third sub-strategy is illustrated by simulation table 5. Here, the relative reductions of repetition and drop-out rates have been chosen in such a way as to compensate each other with respect to the changes in total real input induced. In fact, while both repetition and drop-out rates are being steadily reduced, the total number of pupil years spent by the cohort remains the same.

This theoretical case is apparently of some interest for purposes of practical policy: It demonstrates that planning for a reduction of educational wastage does not, by itself, necessarily imply upward or downward changes of enrolment; combat against repetition on the one hand, and drop-out on the other, can be balanced so that a rather steady utilization of a country's educational capacity may be expected.

In our simulation model, the equilibrium ratio between reductions of drop-out and repetition respectively which is neutral with regard to total real input, can be determined algebraically. [1]

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[1] Total real input can be written as a function of repetition and drop-out rates:

$$I = f(r, d)$$

The equilibrium condition, then, is fulfilled, if

$$dI = \frac{\delta I}{\delta r} \cdot dr + \frac{\delta I}{\delta d} \cdot dd \stackrel{!}{=} 0.$$

that is, if the variation of I, due to marginal simultaneous changes of both r and d, is equal to zero.

Hence we have

$$\frac{dr}{dd} \stackrel{!}{=} - \frac{\frac{\delta I}{\delta d}}{\frac{\delta I}{\delta r}}$$

where $\frac{\delta I}{\delta r}$ as well as $\frac{\delta I}{\delta d}$ are partial first order derivations which can be numerically determined on the basis of equations given in Annex I to this study. It should be noted that this equilibrium solution requires stochastical independence between repetition and drop-out rates - which may not hold in reality.

Simulation table 3

	r	d	Total real input	in %	Output	in %	Actual relation	Efficiency relation	W
Status Quo	30	5	5,134	100	803	100	6.39	4.0	1.60
	29	4	5,175	101	841	104.7	6.15	4.0	1.54
Alternative Strategies	28	3	5,217	102	880	109.6	5.93	4.0	1.48
	27	2	5,257	102	920	114.6	5.71	4.0	1.43
	26	1	5,296	103	960	119.6	5.52	4.0	1.38
	25	0	5,332	104	1 000	124.5	5.33	4.0	1.33

Simulation table 4

	r	d	Total real input	in %	Output	in %	Actual relation	Efficiency relation	W
Status Quo	30	5	5,134	100	803	100	6.39	4.0	1.60
Alternative Strategies	25	4	4,922	95.9	848	105.6	5.80	4.0	1.45
	20	3	4,734	92.2	895	11.4	5.29	4.0	1.32
	15	2	4,547	88.6	933	116.2	4.87	4.0	1.22
	10	1	4,371	85.1	968	120.5	4.52	4.0	1.13
	5	0	4,211	82.0	1 000	124.5	4.21	4.0	1.05

Simulation table 5

	r	d	Total real input	in %	Output	in %	Actual relation	Efficiency relation	W
Status Quo	30	5	5,134	100	803	100	6.39	4.0	1.60
Alternative Strategies	28.375	4	5,134	100	842	105	6.10	4.0	1.52
	26.75	3	5,134	100	882	110	5.82	4.0	1.45
	25.15	2	5,134	100	922	115	5.57	4.0	1.39
	23.6	1	5,134	100	961	120	5.34	4.0	1.33
	22.0	0	5,134	100	1 000	125	5.13	4.0	1.28

2. Extensions of the simple model

2.1 Grade-specific repetition and drop-out rates

The assumption of a uniform repetition and drop-out rate which is constant over all the grades, constitutes an apparent shortcoming of the simple simulation model discussed so far. It may be argued that findings do not apply to practical situations where repetition and drop-out problems are of different magnitude for each grade.

We shall therefore proceed by considering this more differentiated case and extending our assumptions accordingly. In view of the actual experience in elementary school systems of many developing countries, we assume that a particularly high percentage of pupils drops out after the very first grade and that repetition rates show a bimodal distribution, one peak appearing after the first grade and the other at the end of the terminal grade. The "status quo" in other words, would be as follows:-

$r_1 = 25\%$ $r_2 = 20\%$ $r_3 = 15\%$ $r_4 = 40\%$

$d_1 = 15\%$ $d_2 = 7\%$ $d_3 = 5\%$ $d_4 = 5\%$

Starting from this situation we may again simulate a series of "pure" and "mixed" strategies of reducing repetition and/or drop-out, and examine the results in terms of the dependent variables, i.e. total real input, output, actual relation, and the wastage ratio W.

Simulation tables 6, 7, 8 and 9 serve to illustrate these results.

Table 6 simulates an educational policy which concentrates solely on a reduction of the serious drop-out occurring at the end of the first school year. It is assumed that a levelling down of d_1 from 15% to 5% can be accomplished over successive planning periods, without, however, reducing repetition rates at the same time. The results of this type of a "pure" strategy are very clear-cut: Total real input will increase to 4,902 pupil years, i.e. by 13%, whereas output increases by some 20%, thereby making for an improvement of the actual relation from 6.31 to 5.95 pupil years invested per graduate. In that regard, these findings are quite similar to those derived from our simple model above.

Table 7 deals with the complementary "pure" strategy of reducing repetition, holding drop-out rates constant. Presumably, our fictitious educational policy-makers are exclusively interested in a levelling down of the 40% repetition rate at the terminal grade.

Our numerical simulations show that a stepwise reduction of this decisive rate from 40% to 15% would lead to a decrease of the number of pupil years spent by the cohort. On the other hand, output would remain the same, so that less pupil years would be required per unit of output. This apparently implies a lowering of the wastage ratio W from 1.58 to 1.45. Again, these tendencies are entirely compatible with the more general case discussed within the simple model above.

Tables 8 and 9 examine more differentiated "mixed" strategies which aim at reducing both repetition and drop-out simultaneously. We assume that educational policy in these cases is directed toward a general levelling of grade-specific repetition and drop-out rates, trying to attack both problems at the same time. For any particular grade within the cycle, then, the efforts required are of course of different magnitude. Obviously, problems accumulate at grades one and four respectively, while conditions at the third grade are already near the target situation.

Simulation table 6

	r_1	r_2	r_3	r_4	d_1	d_2	d_3	d_4	Total real input	in %	Output	in %	Actual relation	Efficiency relation	W
Status Quo	25	20	15	40	15	7	5	5	4337	100.0	687	100.0	6.31	4.0	1.57
Alternative Strategies	25	20	15	40	13	5	5	5	4494	103.6	729	106.1	6.16	4.0	1.54
	25	20	15	40	11	5	5	5	4596	106.0	753	109.6	6.10	4.0	1.52
	25	20	15	40	9	5	5	5	4698	108.3	776	113.0	6.05	4.0	1.51
	25	20	15	40	7	5	5	5	4800	110.7	800	116.4	6.00	4.0	1.50
	25	20	15	40	5	5	5	5	4902	113.0	824	119.9	5.95	4.0	1.49

Simulation table 7

	r_1	r_2	r_3	r_4	d_1	d_2	d_3	d_4	Total real input	in %	Output	in %	Actual relation	Efficiency relation	W
Status Quo	25	20	15	40	15	7	5	5	4337	100.0	687	100.0	6.31	4.0	1.58
Alternative Strategies	25	20	15	35	15	7	5	5	4249	98.0	687	100.0	6.18	4.0	1.55
	25	20	15	30	15	7	5	5	4174	96.2	687	100.0	6.07	4.0	1.52
	25	20	15	25	15	7	5	5	4108	94.7	687	100.0	5.98	4.0	1.49
	25	20	15	20	15	7	5	5	4051	93.4	687	100.0	5.90	4.0	1.47
	25	20	15	15	15	7	5	5	4000	92.2	687	100.0	5.82	4.0	1.45

Simulation table 8

	r_1	r_2	r_3	r_4	d_1	d_2	d_3	d_4	Total real input	in %	Output	in %	Actual relation	Efficiency relation	W
Status Quo	25	20	15	40	15	7	5	5	4337	100.0	687	100.0	6.31	4.0	1.58
Alternative Strategies	20	15	15	35	13	5	5	5	4304	99.2	742	108.0	5.80	4.0	1.45
	15	15	15	30	11	5	5	5	4266	98,4	771	112.2	5.53	4.0	1.38
	15	15	15	25	9	5	5	5	4274	98.5	792	115.3	5.39	4.0	1.35
	15	15	15	20	7	5	5	5	4288	98.9	813	118.3	5.27	4.0	1.32
	15	15	15	15	5	5	5	5	4307	99.3	834	121.4	5.16	4.0	1.29

Simulation table 9

	r_1	r_2	r_3	r_4	d_1	d_2	d_3	d_4	Total real input	in %	Output	in %	Actual relation	Efficiency relation	W
Status Quo	25	20	15	40	15	7	5	5	4337	100.0	687	100.0	6.31	4.0	1.58
Alternative Strategies	20	15	15	35	12	6	4	4	4338	100.0	753	109.6	5.76	4.0	1.44
	15	15	15	30	9	5	3	3	4378	101.0	812	118.2	5.39	4.0	1.35
	15	15	15	25	6	4	3	3	4451	102.6	854	124.3	5.21	4.0	1.30
	15	15	15	20	3	3	3	3	4529	104.4	898	130.7	5.04	4.0	1.26
	15	15	15	15	3	3	3	3	4463	102.9	898	130.7	4.97	4.0	1.24

In table 8, overall rates of r = 15% and d = 5% are assumed as target values, and the implications of a stepwise approximation of these values are simulated. It can be seen that total real input is lowest for r_4 = 30% and d_1 = 11%, slightly increasing again with further reductions of these rates. On the whole, however, total real input can be expected to decrease together with a considerable growth of output. Similar to our findings in the simple model-case, the "shrinking" effect of reducing repetition rates outnumbers the "expanding" effect of drop-out reduction.

The opposite is true of table 9 where a more radical lowering of drop-out rates to an overall 3% is taken as target value. It turns out that total real input to be invested will now slightly increase by some 3%. However, the parallel growth in the number of graduates will by far exceed the additional inputs required, making for a marked improvement of the actual relation and the wastage ratio W (from 1.58 to 1.24 percent).

Although the picture offered by these somewhat more differentiated simulations is not quite as clear-cut as in the preceding simple model, the same mechanisms are apparently at work. Even selective and limited reductions of repetition and drop-out rates at specific grades result in noticeable improvements of a system's internal efficiency. The antagonistic impacts on total real input of reducing drop-out and repetition respectively are still clearly discernible.

2.2 Considering drop-out as intermediary output

Up to this point, our notion of "educational output" has by definition been restricted to those pupils leaving the cycle only after completion of the terminal grade. The short discussion of competing conceptual alternatives presented in the chapter on "basic concepts" [1] suggests that this definition is best suited to the conditions of elementary education in developing countries.

[1] *Cf. above pp. 7 - 8.*

On the other hand, its restrictive features are obvious: even if we account for that frequently quoted phenomenon of "lapse back into illiteracy" we cannot contend that two, three or four years of primary schooling without completion of the full cycle are in all cases a complete waste of individual efforts and social resources. Literacy is not the only standard to be applied when evaluating learning outcomes. Progress in basic socialization of children, stimulation of interest and of motivation are correlates of mere technical skills which are difficult to measure, but are extremely important. Benefits due to these "invisible" correlates of reading and writing may well accrue even after two or three years of schooling.

To take this kind of argument into account, it appears useful to offer an additional variant of our simulations which is based on a somewhat broader concept of educational output.

One reasonable way of doing this is to include all cases of premature leaving in our measure of total educational output by weighing them with the number of school years after which they have occurred.

For the following simulations, a graduate will therefore be taken as one unit of output, drop-outs occurring after the first grade as one fourth, after the second grade as one half, and after the third grade as three quarters.

The weighed total of drop-out will then be regarded as intermediary output. Accordingly, total output will be composed of intermediary and final output, the latter being defined in the same way as for the preceding simulations.

It is now interesting to see how the results of our extended simulation model will be modified if this broader concept of total output, composed of intermediary and final output, is taken as a basis. For better comparability, the same "status quo" of the system and the same numerical sequences of reducing repetition and drop-out rates will be assumed. Findings are presented in simulation tables 6A, 7A, 8A and 9A.

Table 6A examines a pure and highly selective strategy of reducing drop-out at the first grade, together with a slight reduction of drop-out at grade two. If, as in table 6, only final output is taken into consideration, this strategy gives rise to an output growth of 19.9% and leads to a marked improvement of the wastage ratio.

At the same time, however, reducing drop-out rates means diminishing intermediary output: compared with the status quo, a lowering of drop-out rates to an overall 5% reduces intermediary output from 100% to 71.8%. Although this decline is overcompensated by the strong increase of final output, table 6A indicates that - given our definitional assumptions - no improvements of the internal efficiency can be expected. In spite of successive reductions of drop-out at grade one, the wastage ratio W remains constant at a value of W = 1.35. This is of course a new and rather surprising aspect of our simulations; if one takes the view that less than the prescribed length of schooling is nevertheless of some value, then a reduction of drop-out rates may imply a mere substitution of intermediary for additional final output, with internal efficiency not necessarily being improved.

As against that, table 7A presents basically the same results as the corresponding table 7 above. Although total output, comprising 117 additional units of intermediary output, is now considerably higher, it remains unaltered with the assumed "pure strategy" of successively reducing repetition rates at the terminal grade. As in table 7 above, this constancy of output in absolute terms will apparently lead to a relative decrease of the number of pupil years spent per unit of output: the actual relation will fall from 5.39 to 4.97, and the wastage ratio from W = 1.35 to W = 1.24.

Let us now proceed by examining tables 8A and 9A, and comparing these with the corresponding tables 8 and 9 above. The results are of considerable theoretical interest.

In tables 8 and 8A, as in tables 9 and 9A, two different "mixed strategies" are being simulated, the former giving relatively more weight to reducing repetition, the latter focusing upon a strong reduction of drop-out. As we have already noted above, total real input will therefore decrease in the first case while it increases in the second. In tables 8 and 9, the accompanying fast growth of final output has made for an improvement of the system's internal efficiency. This tendency has been more distinct for table 9 than for table 8.

However, if we turn to tables 8A and 9A, considering also the parallel developments of intermediary output, we arrive at different conclusions. The decrease of intermediary output attributable to a stepwise reduction of drop-out rates, is apparently less marked in table 8A than in table 9A; with respect to the system's internal efficiency, this difference leads to improvements of the wastage ratio which are the same in both tables and at any stage of the respective simulation sequences: W runs from

$$1.35 \rightarrow 1.28 \rightarrow 1.23 \rightarrow 1.21 \rightarrow 1.19 \rightarrow 1.18$$

both in tables 8A and 9A, although the assumed reduction rates for r_1, r_2, r_3, r_4 and d_1, d_2, d_3, d_4 are by no means congruent. [1]

1 *This finding may be generalized to include any other series of reducing d_1, d_2, d_3 and d_4. The resulting improvements of W will be the same for any of these series.*

Simulation table 6A

	r_1	r_2	r_3	r_4	d_1	d_2	d_3	d_4	Total real input	in %	Total Output	in %	of which: Intermediary output	in %	Final output	in %	Actual relation	Efficiency relation	W
Status Quo	25	20	15	40	15	7	5	5	4337	100.0	804	100.0	117	100.0	687	100.0	5.39	4.0	1.35
Alternative Strategies	25	20	15	40	13	5	5	5	4494	103.6	832	103.5	103	88.0	729	106.1	5.40	4.0	1.35
	25	20	15	40	11	5	5	5	4596	106.0	852	106.0	99	84.6	753	109.6	5.39	4.0	1.35
	25	20	15	40	9	5	5	5	4698	108.3	870	108.2	94	80.3	776	113.0	5.40	4.0	1.35
	25	20	15	40	7	5	5	5	4800	110.7	889	110.6	89	76.1	800	116.4	5.40	4.0	1.35
	25	20	15	40	5	5	5	5	4902	113.0	908	112.9	84	71.8	824	119.9	5.40	4.0	1.35

Simulation table 7A

	r_1	r_2	r_3	r_4	d_1	d_2	d_3	d_4	Total real input	in %	Total Output	in %	of which: Intermediary output	in %	of which: Final output	in %	Actual relation	Efficiency relation	W
Status Quo	25	20	15	40	15	7	5	5	4337	100.0	804	100.0	117	100.0	687	100.0	5.39	4.0	1.35
Alternative Strategies	25	20	15	35	15	7	5	5	4249	98.0	804	100.0	117	100.0	687	100.0	5.28	4.0	1.32
	25	20	15	30	15	7	5	5	4174	96.2	804	100.0	117	100.0	687	100.0	5.19	4.0	1.30
	25	20	15	25	15	7	5	5	4108	94.7	804	100.0	117	100.0	687	100.0	5.11	4.0	1.28
	25	20	15	20	15	7	5	5	4051	93.4	804	100.0	117	100.0	687	100.0	5.04	4.0	1.26
	25	20	15	15	15	7	5	5	4000	92.2	804	100.0	117	100.0	687	100.0	4.97	4.0	1.24

Simulation table 8A

	r_1	r_2	r_3	r_4	d_1	d_2	d_3	d_4	Total real input	in %	Total output	in %	of which: Intermediary output	in %	Final output	in %	Actual relation	Efficiency relation	W
Status Quo	25	20	15	40	15	7	5	5	4337	100.0	804	100.0	117	100.0	687	100.0	5.39	4.0	1.35
Alternative Strategies	20	15	15	35	13	5	5	5	4304	99.2	842	104.7	100	85.5	742	108.0	5.11	4.0	1.28
	15	15	15	30	11	5	5	5	4266	98.4	865	107.6	94	80.3	771	112.2	4.93	4.0	1.23
	15	15	15	25	9	5	5	5	4274	98.5	882	109.7	90	76.9	792	115.3	4.85	4.0	1.21
	15	15	15	20	7	5	5	5	4288	98.9	899	111.8	86	73.5	813	118.3	4.78	4.0	1.19
	15	15	15	15	5	5	5	5	4307	99.3	915	113.8	81	69.2	834	121.4	4.71	4.0	1.18

Simulation table 9A

	r_1	r_2	r_3	r_4	d_1	d_2	d_3	d_4	Total real input	in %	Total output	in %	of which				Actual relation	Efficiency relation	W
													Intermediary output	in %	Final output	in %			
Status Quo	25	20	15	40	15	7	5	5	4337	100.0	804	100.0	117	100.0	687	100.0	5.39	4.0	1.35
Alternative Strategies	20	15	15	35	12	6	4	4	4338	100.0	848	105.5	95	81.2	753	109.6	5.11	4.0	1.28
	15	15	15	30	9	5	3	3	4378	101.0	887	110.3	75	64.1	812	118.2	4.93	4.0	1.23
	15	15	15	25	6	4	3	3	4451	102.6	917	114.0	63	53.8	854	124.3	4.85	4.0	1.21
	15	15	15	20	3	3	3	3	4529	104.4	948	117.9	50	42.7	898	130.7	4.78	4.0	1.19
	15	15	15	15	3	3	3	3	4463	102.9	948	117.9	50	42.7	898	130.7	4.71	4.0	1.18

This suggests that with successive reductions of drop-out the gain of efficiency due to additional final output may to some extent be counterbalanced by a loss of intermediary output. It must of course be stressed that this is a theoretical finding which is valid only in the framework of the underlying assumptions. Its practical relevance depends on whether or not educational authorities will insist on regarding premature leaving at the primary level as a complete loss. This is an essentially political question which cannot be answered by theoretical simulations.

II. Analysing effects upon annual unit costs

1. Introduction

Analysing costs of educational wastage and identifying the financial implications of reducing it is an extremely difficult venture. So far, we have taken only some steps towards this task. The question has been: What will be the effect upon educational real inputs and outputs if repetition and drop-out rates are reduced? But we have excluded another, more basic question, namely: How will it be possible to reduce repetition and drop-out rates, what measures will have to be taken and what "costs of transition" will be required?

It is this essential problem which we have to discuss now. Coming to grips with the relationships between annual unit costs and educational wastage requires, first of all, insight into the causes of repetition and school drop-out. From this, an attempt can be made to derive suitable measures against educational wastage. Finally, the costs of implementing these measures may be tentatively assessed.

The following discussion will therefore consist of three subsequent steps, drawing the line from the causal background of wastage to possible countermeasures, and from there to financial implications of remedial action in terms of annual unit costs.

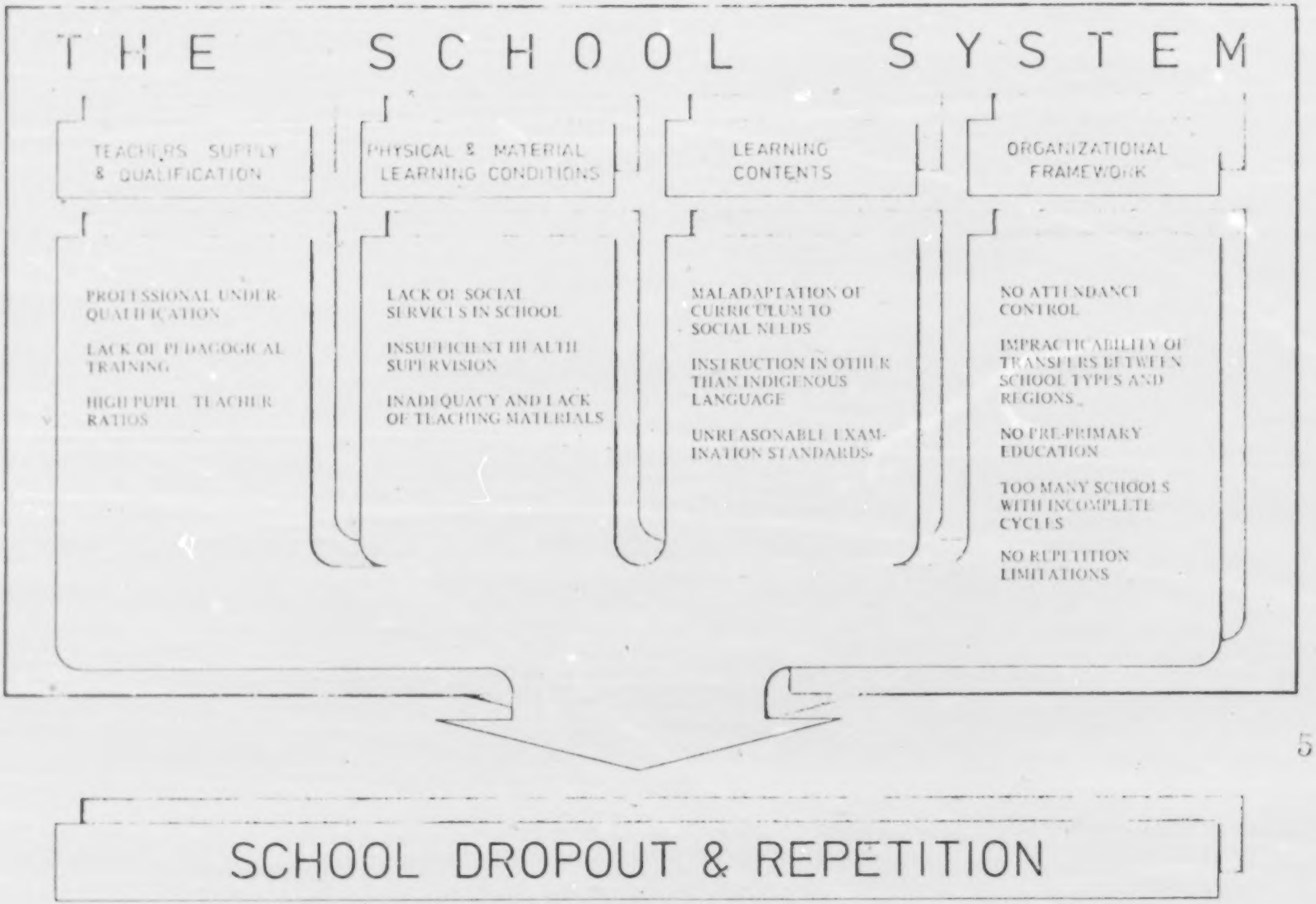
2. The causal background

For an analysis of the causal background of educational wastage it may be useful to distinguish between two sub-sets of causal factors. First of all, we have the organizational, personal, and material conditions within the school system itself. Second, there is the general economic, social and cultural set-up of the society as a whole, notably the social position, economic situation, and cultural attitudes of parents.

It is clear that the first-mentioned set of factors is more relevant for our purposes, because it is more within reach of direct organizational innovations and administrative decisions.

Graph I tries to break down this complex and interrelated cluster of causal factors indicating the most important and most frequent causes of educational backwardness in developing countries:

Shortage of qualified teachers is in many countries the most evident and, at the same time, most serious cause of educational wastage. Single issues are professional under-qualification of many teachers, especially at the decisive first and second grades; those who have had basic training in their specific subjects taught, often lack basic pedagogical abilities; too many old teachers and overcrowded classes due to high pupil-teacher ratios are also frequently mentioned.


THE SCHOOL SYSTEM
TEACHERS SUPPLY & QUALIFICATION
PHYSICAL & MATERIAL LEARNING CONDITIONS
LEARNING CONTENTS
ORGANIZATIONAL FRAMEWORK
PROFESSIONAL UNDER-QUALIFICATION
LACK OF PEDAGOGICAL TRAINING
HIGH PUPIL - TEACHER RATIOS
LACK OF SOCIAL SERVICES IN SCHOOL
INSUFFICIENT HEALTH SUPERVISION
INADEQUACY AND LACK OF TEACHING MATERIALS
MALADAPTATION OF CURRICULUM TO SOCIAL NEEDS
INSTRUCTION IN OTHER THAN INDIGENOUS LANGUAGE
UNREASONABLE EXAMINATION STANDARDS
NO ATTENDANCE CONTROL
IMPRACTICABILITY OF TRANSFERS BETWEEN SCHOOL TYPES AND REGIONS
NO PRE-PRIMARY EDUCATION
TOO MANY SCHOOLS WITH INCOMPLETE CYCLES
NO REPETITION LIMITATIONS
SCHOOL DROPOUT & REPETITION

Another within-school cause of educational wastage is insufficient physical and material conditions of learning in school. Lack of social services such as canteens, free clothes, etc., together with insufficient medical care, create most unfavourable physical preconditions for efficient learning, and lack of textbooks as well as complete absence of audio-visual learning aids settle it.

Next, there are inadequate learning contents, notably antiquated curricula corresponding to some outdated standards rather than to actual social needs; this kind of maladapted curricula create enormous learning difficulties and motivate children to leave prematurely. In many developing countries, instruction is moreover given in languages which most of the children, not being prepared through some form of pre-primary education, cannot follow. Examinations mechanically demanding a formal body of knowledge, instead of finding out about personality formation and basic intelligence of children, are a further cause of educational wastage.

The organizational framework of school systems must be mentioned as another complex cause. Abuses to be remedied range from poor attendance control over difficulties of transfers between schools to the fact that too many schools provide only incomplete cycles, thereby forcing pupils to leave prematurely.

No full account can be given here of the host of social, economic, and cultural conditions which, apart from the school system itself, are responsible for educational wastage in developing countries.

Graph 2 is merely intended to illustrate those factors of pupils' family background which, in principle, can be influenced by "compensatory" remedial action from the side of educational authorities.

There is, first of all, a serious and widespread lack of basic information concerning advantages of complete elementary education in terms of occupational prospects and higher incomes; parents, many of them illiterates, are also not sufficiently informed about educational opportunities for their children, especially if there are frequent changes of home and school.

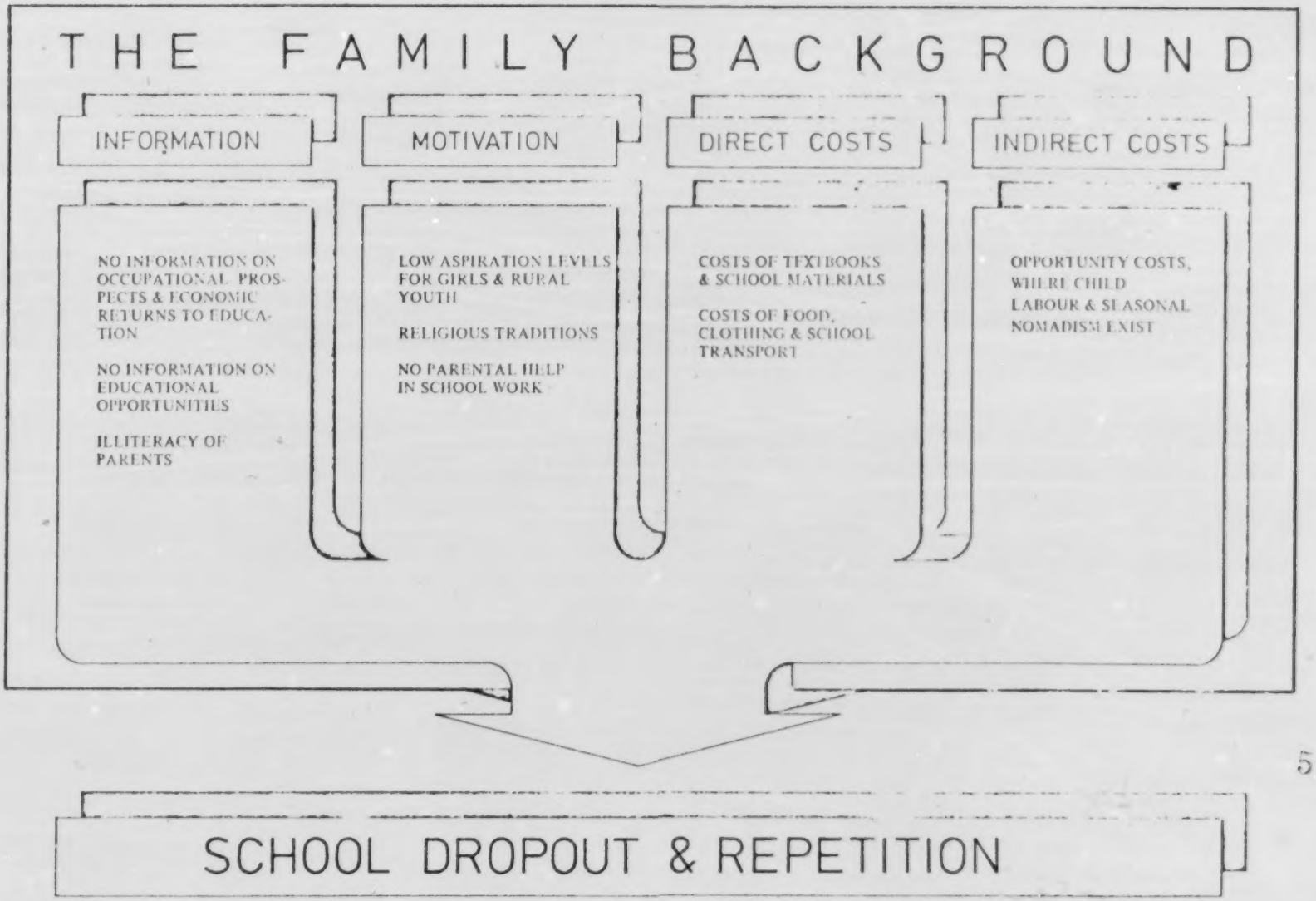
Poor information is aggravated by lack of motivation to keep children in school and to help them in their school work. Educational aspiration levels are traditionally low for girls and for the rural youth.

The direct costs of education accruing to parents must be seen against the background of low incomes, large family size, and frequent unemployment. Parental expenditures for textbooks, school meals, clothing and transport to school very often consume an extremely high percentage of the parents' economic resources. To quote just one example, the report of Burma to the above-mentioned UNESCO/ECAFE Seminar stated that

> "..... the output per capita in 1963/64 was Ks. 329; to keep a child in a primary school cost a parent round about Ks. 150 per year, which includes books, clothes, pocket money, transport charges and food at home." [1]

[1] See: *The Report of Burma to the Technical Seminar on Educational Wastage and School Dropouts; Bangkok 1966 (EDWAST/3:Burma, unpublished manuscript).*

This means that direct annual costs for one child in primary education accounted for almost 50% of monetary family income. It goes without saying that the willingness to give children a complete education will very much suffer from such a burden.


THE FAMILY BACKGROUND
INFORMATION
MOTIVATION
DIRECT COSTS
INDIRECT COSTS
NO INFORMATION ON OCCUPATIONAL PROSPECTS & ECONOMIC RETURNS TO EDUCATION
NO INFORMATION ON EDUCATIONAL OPPORTUNITIES
ILLITERACY OF PARENTS
LOW ASPIRATION LEVELS FOR GIRLS & RURAL YOUTH
RELIGIOUS TRADITIONS
NO PARENTAL HELP IN SCHOOL WORK
COSTS OF TEXTBOOKS & SCHOOL MATERIALS
COSTS OF FOOD, CLOTHING & SCHOOL TRANSPORT
OPPORTUNITY COSTS, WHERE CHILD LABOUR & SEASONAL NOMADISM EXIST
SCHOOL DROPOUT & REPETITION

Additional indirect costs are very difficult to assess, but they may be even higher: child labour even for the elementary school age bracket is very widespread in many developing countries; accordingly, regular school attendance of children implies considerable incomes foregone. The phenomenon of seasonal withdrawal of children from school shows that parents are very much aware of this additional cost factor.

3. Remedial action

Following the short discussion of the causal background of educational wastage we may now attempt to derive remedial measures. Again, not more than a concise survey will be given, using as a guideline the division into main causal factors introduced above:

(1) Measures within the school system

(1.1) Teachers supply and qualification

(1.11) Increasing the number of teachers more rapidly than the parallel growth of enrolment is in most developing countries an urgent task. Notably, this requires a general upgrading of the salary scale to make the profession economically more attractive.

(1.12) At the same time, the percentage of qualified teachers must be raised. Considerable expansion of teacher training institutions together with higher pay according to higher qualifications will be necessary.

(1.13) More weight will have to be given to pedagogical training of teachers, thereby enabling them to give "compensatory" help to endangered and socially deprived pupils. This presupposes a revision of teacher training curricula.

(1.14) As an interim measure, a redistribution of teachers may be suggested, appointing the most qualified teachers to the very first grades where, as a rule, the dice are being cast for the pupils' prospective school careers.

(1.2) Physical and material learning conditions

(1.21) The physical condition of pupils should be improved by installing more school canteens, intensifying the system of health supervision, and distributing free school clothing.

(1.22) As a best solution, transition to a system of boarding schools comes into question. This would certainly be the most efficient, but also the most expensive strategy of controlling and improving the physical condition of pupils.

(1.23) Material learning conditions mainly depend on the number and quality of textbooks and other classroom equipment. Even more radical measures would include introduction of audio-visual learning aids such as television instruction.

(1.3) Learning contents

(1.31) A comprehensive revision of elementary school curricula is a high priority task in many developing countries; better adaptation to occupational and social needs as well as to practical requirements of daily life is called for. This is an issue where the strong influence of "external" maladaptation of schooling upon "internal" inefficiency in terms of weak motivation and drop-out of pupils is very obvious.

(1.32) Major efforts are required to convert instruction and textbooks to the indigenous language where this is not yet the case and where no system of pre-primary preparatory courses exists.

(1.33) In many cases, a revision of grade pass examination standards appears to be a highly useful measure against educational wastage. Particularly in the first grades, educational attainment should be measured in terms of "personality development" rather than mastery of certain prescribed subjects.

(1.4) The organizational framework

(1.41) Although primary schooling is compulsory in almost all developing countries efficient control of actual school attendance is very rare. Additional administration staff would of course be required for this purpose.

(1.42) Improving opportunities of transfer both between regions and different school types is likely to considerably reduce school drop-out in countries where there is strong migration, forcing pupils to change home and schools.

(1.43) Another highly urgent measure would be to rapidly reduce the number of schools providing only incomplete cycles. Yet this would require extraordinary financial efforts.

(1.44) The same is true of the introduction and/or expansion of pre-primary education.

(1.45) Educational wastage will also be almost automatically reduced if educational authorities decide on selectively lowering grade-pass standards, restricting the number of repetitions permitted, or even on gradually introducing automatic promotion. However, it is clear that such measures, if not accompanied by some strategy of furthering and controlling pupils' attainment, will imply forcible curtailing rather than solution of the problem. [1]

[1] *An interesting experiment is quoted in the Report of Malaysia to the above-mentioned UNESCO/ECAFE Seminar: Some time after the introduction of automatic promotion in primary education, teachers were asked to report the percentage of pupils not deserving to be promoted, due to low attainment. The remarkable outcome of this subsequent check of the efficiency of the new scheme was that the average repetition rate, deemed necessary by the teachers, had fallen to 10%. See: Report of Malaysia to the Technical Seminar on Educational Wastage and School Dropouts; Bangkok 1966 (EDWAST/3: Malaysia, unpublished manuscript, pp. 12/13).*

(1.46) As a first step towards automatic promotion, different forms of individual tuition, ability grouping, etc. might be introduced, complementing but not superseding the main principle of grade promotion. This would of course increase the working load of teachers, and therefore require more and specially trained teaching staff.

(2) Measures to compensate for family background

(2.1) Information

(2.11) Poor information of parents, especially in rural areas, may be systematically improved by all sorts of literacy campaigns, vocational counselling, campaigns against premature marriage, touring exhibitions giving information on advantages of complete schooling, etc.

(2.2) Motivation

(2.21) An efficient measure compensating for the unfavourable social climate of lower class and rural families is again the introduction of comprehensive pre-primary schooling.

(2.22) Another highly promising solution is of course gradual transition to a system of boarding schools; this would have the double advantage of both improving physical and material learning conditions and levelling out, at least to some extent, inequalities of educational opportunities due to different family backgrounds.

(2.3) Direct costs

(2.31) Ways of reducing direct costs accruing to parents are obvious: free supply of textbooks and other school materials must be ensured. A system of social services providing school meals and clothing should contribute to freeing parents from their financial burden.

(2.32) Another highly important measure in countries with poor traffic infrastructure would be provision of a comprehensive system of school transport.

(2.4) Indirect costs

(2.41) Compensation of opportunity costs due to income foregone would require scholarships paid according to parental income. It can be expected that both the costs and the remedial effect upon school withdrawal of introducing some kind of a compensatory scholarship scheme at the primary level would be extraordinary.

4. Cost implications

4.1 Lack of empirical data

Little or no empirical evidence is available on cost implications of any of the remedial measures which we have discussed. An assessment of the additional costs required for, say, improving the pupil-teacher ratio by X percent, let alone such differentiated measures as introduction of a school transport system or development of a new curriculum, is hardly possible on a general level. Some countries may have started pilot-projects covering one or another of these measures, but information on costs and results is rarely being published, and, as a rule, not to be generalized.

Moreover, strategies of reducing educational wastage will usually not be restricted to one single measure; in most cases, a whole set of different measures complementing each other will be employed. Accordingly, even a tentative assessment of the costs involved turns out to be extremely difficult.

The direct way of identifying the "costs of transition" required to reduce repetition and drop-out rates by calculating the single and combined cost implications of the whole set of remedial measures is therefore not feasible.

There is also another possible way of throwing some light on the relationship between unit costs and educational wastage and that is by using a retrospective correlations approach. We have tried to do this by correlating annual unit costs for primary education in different countries and in different points in time with the corresponding average rates for repetition and drop-out in primary education. However, no clear-cut pattern emerged from these tentative calculations.

4.2 A tentative classification

To get to grips with the problem of transition costs, one may instead attempt an initial classification of all remedial measures discussed according to their cost intensity.

This is being done in Graph 3. A "cost-neutral" strategy of reducing wastage, then, would include such measures as better control of school attendance, introduction of more adequate examination standards, restriction of the number of repetitions permitted, etc. [1]

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[1] *In Graph 3, the numbers given in brackets refer to our discussion of single measures on pp. 41 - 43.*

All these measures are of course not "cost-neutral" in the exact sense, but their implementation requires comparatively little effort, and their rôle within the total educational budget is likely to be almost negligible.

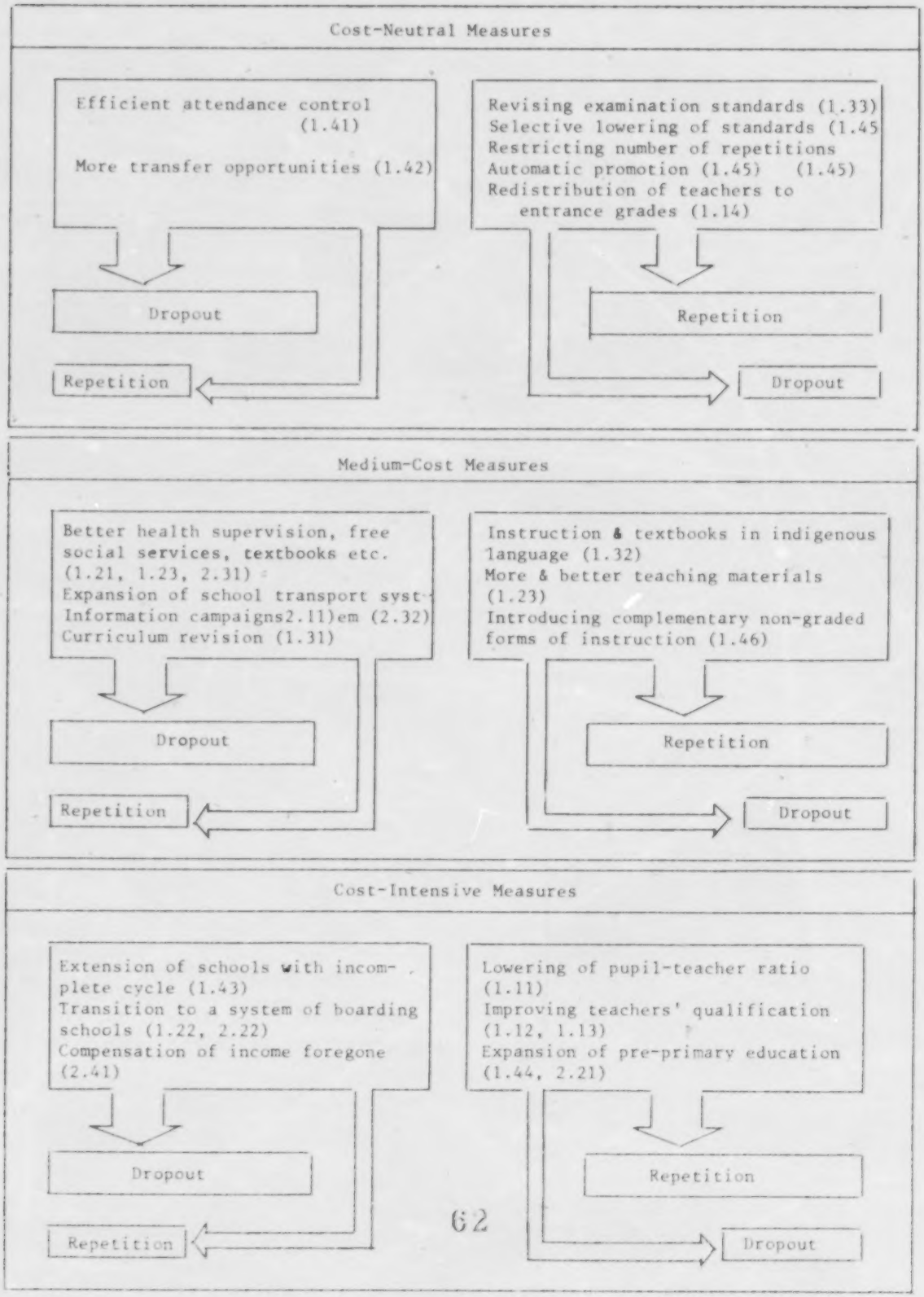
An additional breakdown is introduced in Graph 3 between those measures primarily aiming at a reduction of drop-out and those which are more directed towards combatting repetition. Although the effects are often not clearly separable, it is important to know what aspect of the wastage phenomenon is primarily affected by a given measure.

In the next category we find the elements of a "medium-cost" strategy of combatting educational wastage. This implies, amongst others, provision of free social services in school, better medical care, installation of a school transport system, revision of primary school curriculum, and adaptation of textbooks and instruction to the native language. On the whole, we have a highly heterogeneous set of relevant measures, most of them requiring considerable preparation and organizational efforts. Yet it can reasonably be expected that the costs implied by these measures will not be too spectacular. This is partly a simple question of orders of magnitude: In primary education budgets of most developing countries, expenditures for school textbooks, welfare services, canteens, transport, etc., account for not more than some 5% to 10% of the total. Even a 100% increase in these expenditures, due to a substantial effort to combat educational wastage, would mean a rather slight increase in terms of the total primary education budget. Costs per pupil, in other words, are likely to increase only moderately, if educational authorities restrict themselves to what is here called the "medium-cost" strategy of combatting wastage.

For some measures, such as creation of a system of health supervision, information campaigns, and expansion of school transport, a considerable part of the costs may moreover be borne by other ministries, or improvements may emerge as a by-product of activities in the realm of public health, traffic, etc. This, too, would contribute to keeping the necessary increase in educational unit costs within reasonable limits.

Finally, we have a "cost-intensive" strategy, consisting of measures that involve major structural changes and extraordinary investment efforts.

Graph 3


Cost-Neutral Measures
Efficient attendance control (1.41)
More transfer opportunities (1.42)
Dropout
Repetition
Revising examination standards (1.33)
Selective lowering of standards (1.45
Restricting number of repetitions
Automatic promotion (1.45) (1.45)
Redistribution of teachers to entrance grades (1.14)
Repetition
Dropout
Medium-Cost Measures
Better health supervision, free social services, textbooks etc. (1.21, 1.23, 2.31)
Expansion of school transport syst
Information campaigns2.11)em (2.32)
Curriculum revision (1.31)
Dropout
Repetition
Instruction & textbooks in indigenous language (1.32)
More & better teaching materials (1.23)
Introducing complementary non-graded forms of instruction (1.46)
Repetition
Dropout
Cost-Intensive Measures
Extension of schools with incomplete cycle (1.43)
Transition to a system of boarding schools (1.22, 2.22)
Compensation of income foregone (2.41)
Dropout
Repetition
Lowering of pupil-teacher ratio (1.11)
Improving teachers' qualification (1.12, 1.13)
Expansion of pre-primary education (1.44, 2.21)
Repetition
Dropout

Take the case of introducing pre-primary education which aims at compensating for different social origins of children and removing linguistic barriers and low motivation. This strategy would presuppose not only the building of a large number of kindergarten schools, but also provision of well trained kindergarten teachers. Similarly, the aim of increasing the percentage of qualified primary teachers will put a great strain, both in terms of organizational and financial efforts, on the teacher training system. The same is true of the other measures included in a "cost-intensive" strategy: extension of primary schools with incomplete cycles, construction of boarding schools, introduction of a scholarship scheme to compensate for indirect costs borne by the parents.

4.3 Unit cost curves

Now, starting from this classification of three strategies with different cost intensity, how can we illustrate the possible relationships between a reduction of educational wastage and the required increase in annual unit costs?

Graph 4 below attempts to give a general and inevitably rather abstract answer to this question. Each strategy is illustrated in a co-ordinate system where annual unit costs, expressed as an index, are plotted against the wastage ratio W. Any measure will supposedly influence unit costs, reducing W at the same time. Take as an arbitrary starting point a value of 2.1 for W and of 100.0 index points for annual unit costs.

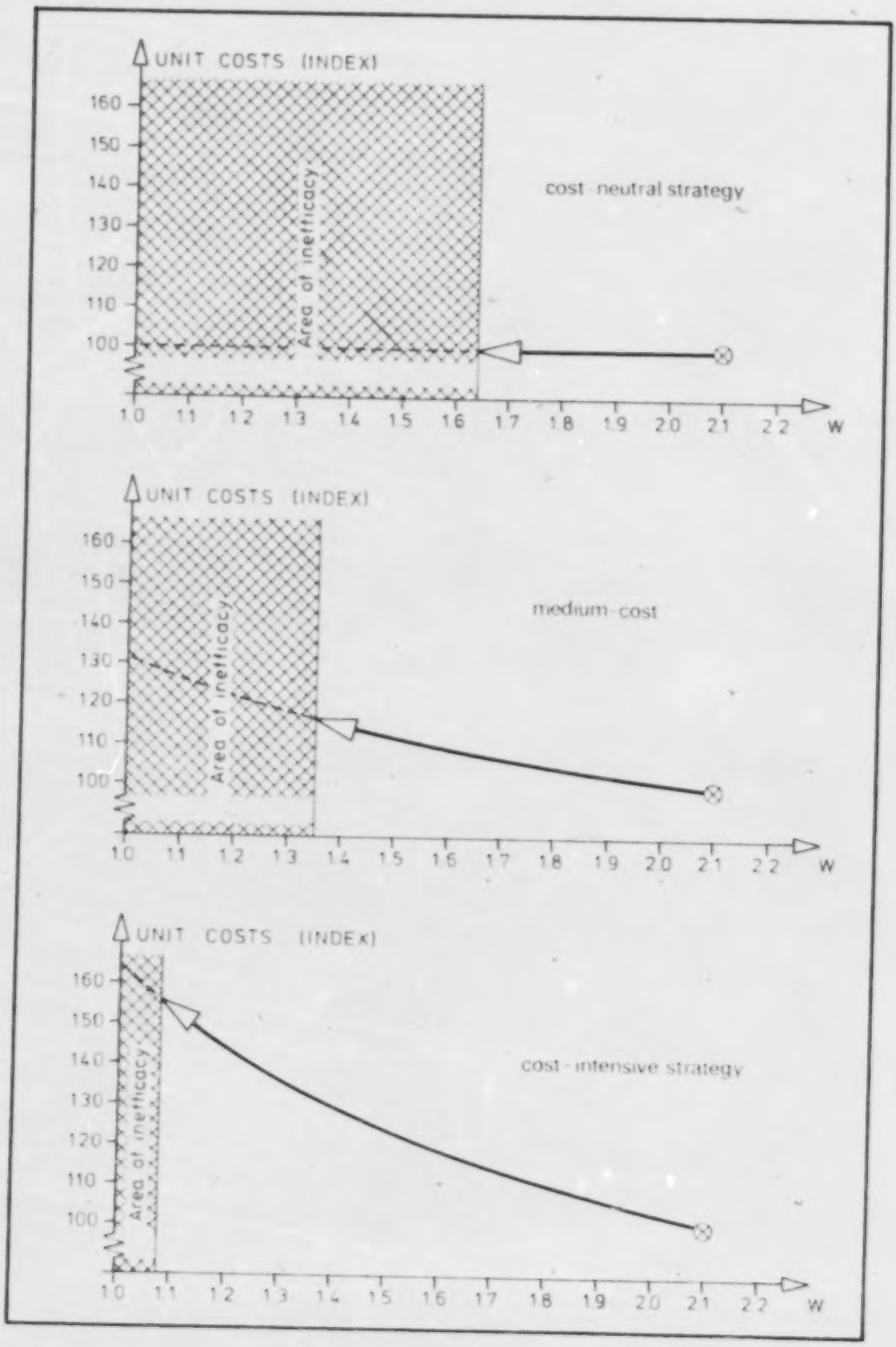
The cost-neutral strategy, then, will steadily reduce W by lowering repetition and drop-out rates; no increase of unit costs will be required, but the range of efficiency of this strategy is likely to be rather small; in the graph we assumed that lowering W beyond a value of 1.65 will not be possible. Exactly where the "area of inefficiency" begins for a given strategy, is of course an empirical question to which no general answer can be given.

If the "medium-cost" strategy is employed to reduce repetition, drop-out and thereby "W", the unit costs curve will turn out to be slightly ascending. It is moreover to be expected that the slope of the cost curve will be moderately exponential rather than linear, because with successive reductions of educational wastage, problems and obstacles will show to be more and more persistent and therefore increasingly difficult and expensive to remove. In other words, the marginal cost of increasing efficiency will increase with the increase of efficiency. The coverage of the "medium-cost" strategy will presumably be greater than if exclusively cost-neutral measures were employed; we have assumed that the "area of inefficiency" begins with a value of around W = 1.35.

The "cost-intensive" strategy, composed of highly expensive and far-reaching measures, is likely to reduce educational wastage more radically. The remaining "area of inefficiency" will presumably be located around a value of W = 1.05 only. However, at the same time the rise of annual unit costs caused by these measures will be more or less spectacular. The unit cost curve illustrating the "cost-intensive" strategy in Graph 4 is therefore considerably steeper than is the case for the preceding strategies; for the reason already discussed, a non-linear shape of the curve is again assumed.

To conclude this discussion of alternative unit cost curves, we have to restate the fact that Graph 4 presents essentially a model case which has so far not strictly been validated on the basis of empirical case-study research. Our assumptions concerning non-linearity, continuity, and slope of the cost curves as well as location of the "area of inefficiency" can at best claim a certain plausibility. Further research on the national or case-study level is required to base these cost curves on solid empirical grounds. Yet, as long as there are no empirical clues available, our "model type" treatment of the problem offers the advantage of integrating the relationships between repetition, drop-out, and annual unit costs into the framework of our preceding simulations of enrolment and output effects.

GRAPH 4


UNIT COSTS (INDEX)
160
150
140
130
120
110
100
Area of inefficacy
cost-neutral strategy
1.0 1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8 1.9 2.0 2.1 2.2 W
UNIT COSTS (INDEX)
160
150
140
130
120
110
100
Area of inefficacy
medium-cost
1.0 1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8 1.9 2.0 2.1 2.2 W
UNIT COSTS (INDEX)
160
150
140
130
120
110
100
Area of inefficacy
cost-intensive strategy
1.0 1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8 1.9 2.0 2.1 2.2 W

Hence, we are now in a position to combine these hitherto separate lines of discussion in a comprehensive simulation exercise, thereby offering a clear picture of the various interrelated consequences of reducing educational wastage, in terms of pupil years invested, prospective numbers of graduates, annual unit outlays, expenditure totals, and, finally, costs per graduate.

III. A comprehensive simulation model

1. Assumptions and results

Now that all necessary elements have been collected, we may proceed by simulating comprehensively the consequences and notably cost implications of reducing educational wastage. As with our previous "partial" simulations of enrolment and output effects, calculations refer again to a cohort of 1,000 pupils progressing through a four-grade primary school cycle. We have noted that the results of an extended simulation model, which assumes grade-specific repetition and drop-out rates, are quite in line with those of the simple model that we discussed first. [1] For computational ease, let us therefore assume uniform repetition and drop-out rates of r = 40.0% and d = 8.0% which are constant over all the grades.

[1] *See our comments to simulation tables 6 to 9 on pp. 26-31 above.*

Now, starting from this serious situation, an educational policy maker may consider a stepwise reduction of educational wastage in the following way:

40.0%	-	35.0%	-	30.0%	-	25.0%	-	20.0%	-	15.0%	-	10.0%	-	5.0%	-	0.0%
8.0%	-	7.0%	-	6.0%	-	5.0%	-	4.0%	-	3.0%	-	2.0%	-	1.0%	-	0.0%

In other words, the envisaged strategy is of the "mixed" type, involving a simultaneous reduction of both repetition and drop-out rates.

Our fictitious decision maker, then, needs information on preconditions as well as consequences of this strategy. In particular, he wants to know to what extent annual unit costs will have to be raised to produce the desired reduction of repetition and drop-out rates, and what the outcomes in terms of pupil years invested, number of graduates produced, total costs and costs per graduate will be. All these factors, if taken together, will allow one to assess the additional costs and benefits of remedial action, and to compare this with the costs and benefits of the present situation.

As regards preconditions of wastage reduction, our decision maker faces a choice problem: he can resort to those measures which we have subsumed under the "cost-neutral" strategy; or he can employ the "medium-cost" strategy, thereby putting up with an increase of annual unit costs; or he may finally make use of the "cost-intensive" strategy which would imply a very marked unit cost increase. The pattern of consequences will be different for each of these strategies.

1.1 The "cost-neutral" strategy

Let us first simulate the "cost-neutral" strategy. From our preceding discussions we know that this strategy is not likely to require additional costs per pupil; annual unit costs can therefore be expected to remain

constant at a value of 100.0 index points which we assume for the status quo. 1

The "comprehensive simulation table 1", then, shows the implications and consequences of this strategy. 2 On principle, these consequences seem to be most favourable: If a parallel reduction of repetition and drop-out rates to the ideal value of zero were possible without any increase in annual unit costs, then both total costs and costs per graduate could be lowered to 400,000 and 400.0 index units respectively; in other words, more than half of the costs per graduate actually incurred could be saved. However, as we have seen, the range of efficiency of the "cost-neutral" strategy is likely to be quite narrow. We cannot expect that the rather small-scale measures involved will effect more than reducing "r" from 40.0 to 30.0, and "d" from 8.0 to 6.0 per cent. The best result which is actually within reach of this strategy would therefore be a reduction of total costs from 544,800 to 501,900, and of costs per graduate from 836.9 to 656.9. The corresponding number of graduates would be 764, against 651 in the initial situation. On the whole, this would still imply considerable improvements, both in terms of absolute budgetary savings and of cost-benefit relations, as compared with the status quo.

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1 *If annual unit costs are measured in index units, then the same is of course true of total costs and costs per graduate. In the case of future application to a given country, all these amounts can easily be transformed into units of national currency.*

2 *The table is constructed in the following way: columns (1) and (2) indicate the envisaged series of reducing repetition and drop-out rates. Column (3) gives the required increase in annual unit costs - which is nil in the case of table 1. In general, the series appearing in column (3) are derived from the unit cost curves in Graph 4. Columns (4), (5) and (6) have been calculated in the same way as for all preceding partial simulation tables, using the mathematical approach explained in Annex I. Column (6) has been calculated by multiplying columns (3) and (4), and column (7) by dividing column (6) by column (5).*

1.2 The "medium-cost" strategy

Let us now turn to the "medium-cost" strategy, by examining the "comprehensive simulation table 2". Column (3) illustrates the necessary increase in annual unit costs which is presumably implied by the various measures that we have subsumed under this strategy. If we assume this series to be more or less realistic, then total costs will remain almost constant with successive reductions of repetition and drop-out: While initially they were 544,800 index units, they are still 528,000 index units in the ideal situation. Costs per graduate, however, which is the principally more important cost concept, turn out to be steadily decreasing: If the ideal (W = 1.00) is taken as reference situation, then the differential costs 3 per graduate are 836.9 minus 528.0, or 308.9 index units. Therefore, the important result of these simulations is that, in spite of the necessity to increase annual unit costs, a lowering of costs per graduate will be possible. This will be the case even if we account for the fact that the reach of the "medium-cost" strategy is also likely to be rather limited. Assuming that the limits will be around W = 1.35, this strategy would lead to a slight lowering of total costs from 544,800 to 537,900, and to a considerable reduction of costs per graduate from 836.9 to 626.9 index points. At the same time, the number of graduates would increase from 651 to 858.

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3 *Cf. above pp. II/12 of this study.*

Comprehensive simulation table 1: the cost-neutral strategy

	(1) r	(2) d	(3) annual unit costs	in %	(4) total real input	in %	(5) Output	in %	(6) Total Costs	in %	(7) Costs per graduate	in %	(8) W
Status Quo	40	8	100	100.0	5448	100.0	651	100.0	544,800	100.0	836,9	100.0	2.10
	35	7	100	100.0	5229	96.0	710	109.1	522,900	96.0	736,5	88.0	1.84
	30	6	100	100.0	5019	92.1	764	117.4	501,900	92.1	656,9	78.5	1.64
	25	5	100	100.0	4822	88.5	815	125.2	482,200	88.5	591,7	70.7	1.48
	20	4	100	100.0	4637	85.1	858	131.8	463,700	85.1	540,4	64.6	1.35
	15	3	100	100.0	4462	81.9	898	138.0	446,200	81.9	496,9	59.4	1.24
	10	2	100	100.0	4298	78.9	935	143.6	429,800	78.9	459,7	55.0	1.15
	5	1	100	100.0	4146	76.1	969	148.9	414,600	76.1	427,9	51.1	1.07
Area of Inefficiency	0	0	100	100.0	4000	73.4	1000	153.6	400,000	73.4	400,0	47.8	1.00

Comprehensive simulation table 2: the medium-cost strategy

	(1) r	(2) d	(3) annual unit costs	in %	(4) total real input	in %	(5) Output	in %	(6) Total Costs	in %	(7) Costs per graduate	in %	(8) W
Status Quo	40	8	100	100.0	5448	100.0	651	100.0	544,800	100.0	836,9	100.0	2.10
	35	7	104	104.0	5229	96.0	710	109.1	543,800	99.8	765,9	91.5	1.84
	30	6	108	108.0	5019	92.1	764	117.4	542,000	99.5	709,4	84.8	1.64
	25	5	112	112.0	4822	88.5	815	125.2	540,000	99.1	662,6	79.?	1.48
	20	4	116	116.0	4637	85.1	858	131.8	537,900	98.7	626,9	74.9	1.35
Area of Inefficiency ↑	15	3	120	120.0	4462	81.9	898	138.0	535,400	98.3	596,2	71.2	1.24
	10	2	124	124.0	4298	78.9	935	143.6	533,000	97.8	570,0	68.1	1.15
	5	1	128	128.0	4146	76.1	969	148.9	530,700	97.4	547,7	65.4	1.07
↓	0	0	132	132.0	4000	73.4	1000	153.6	528,000	96.9	528,0	63.1	1.00

Comprehensive simulation table 3: the cost-intensive strategy

	(1) r	(2) d	(3) annual unit costs	in %	(4) total real input	in %	(5) Output	in %	(6) total costs	in %	(7) Costs per graduate	in %	(8) W
Status Quo	40	8	100	100.0	5448	100.0	651	100.0	544,800	100.0	836,9	100.0	2.10
	35	7	108	108.0	5229	96.0	710	109.1	564,700	103.7	795,3	95.0	1.84
	30	6	116	116.0	5019	92.1	764	117.4	582,200	106.9	762,0	91.1	1.64
	25	5	124	124.0	4822	88.5	815	125.2	597,900	109.7	733,6	87.7	1.48
	20	4	132	132.0	4637	85.1	858	131.8	612,100	112.4	713,4	85.2	1.35
	15	3	140	140.0	4462	81.9	898	138.0	624,700	114.7	695,6	83.1	1.24
	10	2	148	148.0	4298	78.9	935	143.6	636,100	116.8	680,3	81.3	1.15
	5	1	156	156.0	4146	76.1	969	148.9	646,800	118.7	667,5	79.8	1.07
Area of Inefficiency	0	0	164	164.0	4000	73.4	1000	153.6	656,000	120.4	656,0	78.4	1.00

1.3 The "cost-intensive" strategy

Finally, the "comprehensive simulation table 3" examines the implications of the "cost-intensive" strategy. The increase of unit costs caused by the different remedial measures involved is likely to be very marked; taking the cost curve in Graph 4 as a preliminary basis, we have assumed an increase of almost two thirds (from 100.0 to 164.0 index points). On the other hand, these measures are supposedly very far reaching, and a reduction of educational wastage coming close to the optimum situation can be expected. For the purpose of our simulation, it has been assumed that the "area of inefficiency" begins at a value of W = 1.07, corresponding to a repetition rate of 5.0% and a drop-out rate of 1.0%. If this assumption appears plausible, then the "cost-intensive" strategy would enable a lowering of costs per graduate from 836.9 to 667.5 index points. This is a remarkable outcome, all the more so, as total costs tend to increase with successive reductions of wastage. So the "cost-intensive" strategy entails an additional financial burden in absolute terms while in relative terms, i.e. in terms of costs per unit of output, it leads to considerable improvements. The latter fact is of course due to the spectacular growth in the number of graduates produced: if educational authorities manage to reduce the wastage ratio from 2.10 to 1.07, 969 instead of 651 of the initial 1,000 school entrants will successfully complete the cycle.

2. Optimum decisions

We have seen that educational decision makers can choose between the cost-neutral, the medium-cost and the cost-intensive strategy of reducing educational wastage. For each of these strategies, a comprehensive simulation table has been presented, showing that both the range of efficiency and the various numerical implications are different for each particular strategy.

It is now possible to compare the relatively best soluations within each strategy, thereby trying to identify an overall optimum strategy of combating educational wastage.

Best solutions for different strategies

	costs per graduate	total costs	number of graduates
cost-neutral strategy	656.9	501,900	764
medium-cost strategy	626.9	537,900	858
cost-intensive strategy	667.5	646,800	969

Now, there are apparently three criteria which have to be considered in judging the relative advantages and disadvantages of these decision alternatives:

1. Which strategy produces the lowest costs per graduate?
2. Which strategy requires least total costs?
3. Which strategy implies the highest increase in the number of graduates produced?

In terms of the first criterion - minimizing costs per graduate - the "medium-cost" strategy is obviously to be preferred to the other two; it entails a lowering of costs per graduate from initially 836.9 to 626.9 index units, as compared with 656.9 for the "cost-neutral", and 667.5 for the "cost-intensive" strategy; after all, these are minor differences if the remarkable rates of

improvement against the status quo ante are taken into account.

However, the second criterion may also become highly relevant, particularly in countries where governments are not able to expand total costs beyond a given budgetary ceiling. In terms of this criterion, the "medium-cost" strategy does not come off so well: It implies a slight lowering of total costs as against the initial situation, but in this respect the "cost-neutral" strategy will apparently do better, as it entails a noticeable lowering of total costs from 544,800 to 501,900 index units. In contrast, the "cost-intensive" strategy would lead to a strong increase of total costs, thereby making the greatest demands on a country's financial capacity.

The importance of the third criterion results from the apparent need of many developing countries for sufficient and steadily growing supply of qualified school leavers. The aim of producing the highest possible number of graduates may well, therefore, compete with that of minimizing costs per graduate, or keeping total costs within certain limits.

In terms of this criterion, the "cost-intensive" strategy promises by far the best results: It would lead to increasing the number of graduates from 651 to 969, whereas the other two strategies would yield an output of 764 and 858 only.

Which of these competing criteria is regarded as most relevant, is apparently a question of political priorities. In the long run, a rational anti-wastage policy would require that educational policy makers think primarily in terms of cost-benefit relations. For this reason, the objective of minimizing costs per graduate deserves to be the principally dominant criterion; the optimum solution would then consist of choosing that strategy yielding the relatively lowest cost per graduate. In the case of our simulation exercise, this would be the "medium-cost" strategy.

However, the particular economic and social situation of a country may require that other criteria are temporarily emphasized. For instance, if there is an urgent shortage of qualified school leavers, educational authorities may well be led to pursue that particular strategy which gives the highest possible output, but which implies less favourable costs per graduate. In our case, the "cost-intensive" strategy would fulfil this condition.

Similarly, the objective of minimizing costs per graduate as well as that of maximizing the educational output may be disregarded in times when a country faces serious budgetary bottlenecks; this means that countries may sometimes be forced to pursue a conditioned optimum strategy which is subjected to a given budgetary constraint, rather than a free optimum strategy. In this connection, the second criterion - that of keeping total costs within certain limits - plays of course an important rôle, and the "cost-neutral" strategy which enables one to have better internal efficiency together with lower total costs may appear as the most favourable.

E. SUMMARY AND CONCLUSIONS

The present study has left the solid grounds of empirical research which restricts itself to describing patterns of educational wastage as they have been observed in various developing countries. Instead, we have flown a kite by trying to explore a new approach to the problem which leads towards remedial action rather than mere description.

At the present state of our knowledge it proved necessary to treat the problem of reducing educational wastage in an abstract "model-type" manner; we have examined school careers of a fictitious cohort of new entrants in a fictitious school cycle, simulating alternative careers under various assumptions which, again, were not always close to reality.

Nevertheless, this kind of simulation appears to be essential for a basic understanding of the complex implications involved in any strategy of combating educational wastage. What matters is a better insight into the crucial variables of the game and into the most relevant interdependencies between them. The application of this insight to the specific conditions of a given country's school system is then but a natural follow-up.

There is, however, one main finding of the present study which transcends the realm of theoretical relevance: Any reduction of educational wastage, whether focusing on drop-out or on decreasing repetition, whether selective or covering all grades, whether based on cost-neutral or cost-intensive measures, is very likely to lead to an increased number of graduates and to lower costs per graduate; these improvements may be more or less marked according to the particular strategy chosen, but our simulations suggest that the reverse is unlikely to happen.

This finding should provide a major stimulus to educational authorities to embark upon a comprehensive and well-planned strategy of combating educational wastage in their countries. This is both a pedagogical and an economic postulate.

To begin with, such strategies may be put to an experimental test on the single school level. If the wastage pattern in a particular primary school is known, a series of adequate measures can be designed and implemented, and implications in terms of additional unit costs required as well as results in terms of reduced repetition and/or drop-out rates can be examined. Preliminary case-study research of that kind would notably provide empirical clues as to the shape and slope of what we have called the "unit cost curves". So far, these unit cost curves must be considered as the weakest, i.e. empirically least reliable, part of our simulations. Further research must therefore attempt to base these crucial relationships on solid empirical grounds.

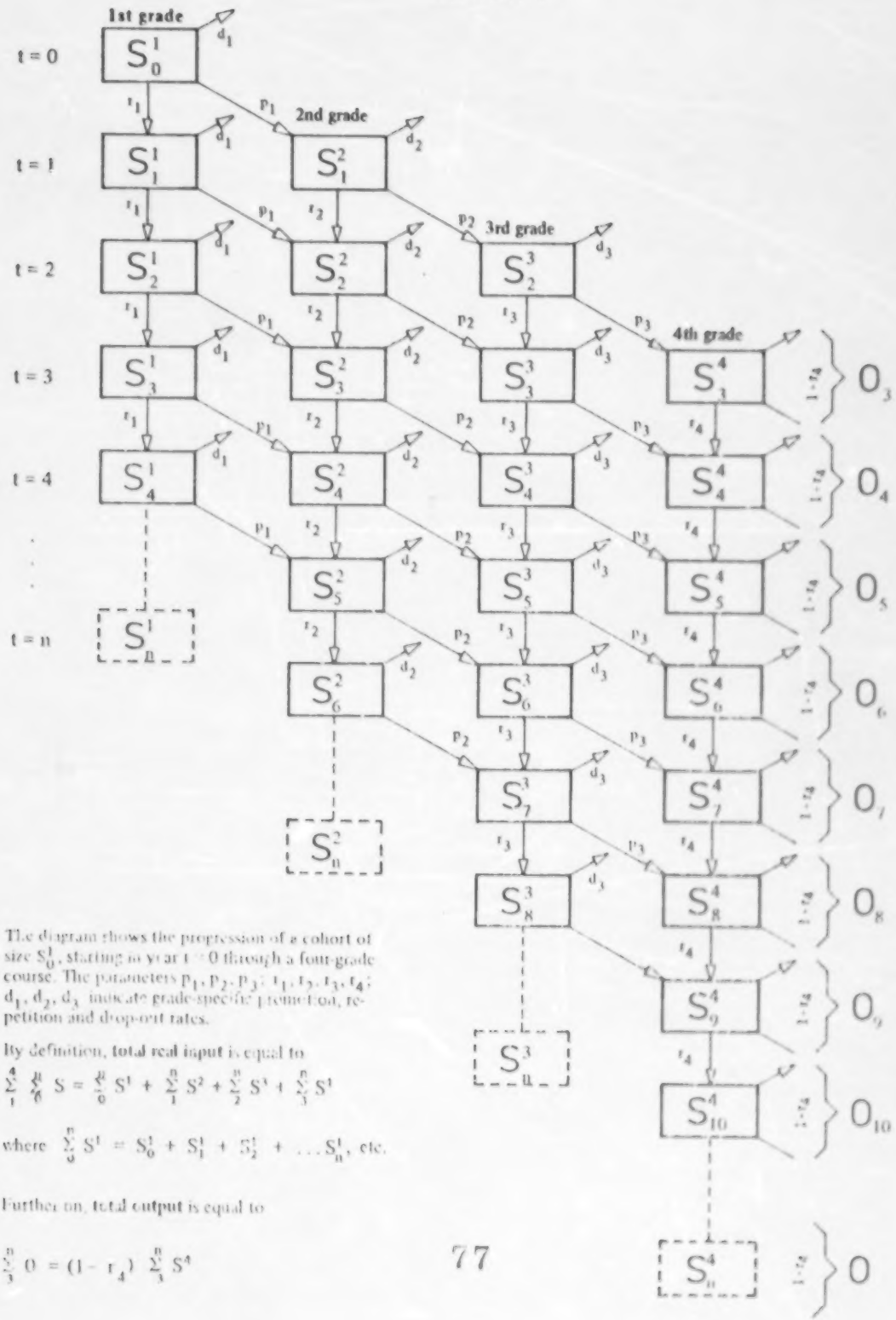
In a next step, the simulations approach proposed in the present study may be computerized. This will not pose any particular problems; on the contrary, it will easily be possible to adjust the general simulation model to the real conditions of a particular school system: observed numbers of new entrants instead of a fictitious cohort of 1,000 pupils can then be taken as initial input into the school cycle. In addition, the model can be extended to comprise a whole sequence of yearly new entrants, simulating their flows through the school cycle simultaneously.

Annex II to this study includes a number of flow-diagrams representing the actual flows of pupils through the primary school cycle of different countries. If a computerization and extension of the present pilot simulations approach were put into practice, the actual flows could easily be complemented by alternative flow-diagrams, thus allowing a comparison of the outcomes of different courses of anti-wastage action. Such an approach would of course come closer to real planning and costing problems than the "single cohort" model used in the present pilot study.

A N N E X I

Algebraic Elements of Cohort Simulation

ANNEX I



The diagram shows the progression of a cohort of size S_0^1, starting in year $t = 0$ through a four-grade course. The parameters p_1, p_2, p_3; r_1, r_2, r_3, r_4; d_1, d_2, d_3 indicate grade-specific promotion, repetition and drop-out rates.

By definition, **total real input** is equal to

$$\sum_{1}^{4} \sum_{0}^{n} S = \sum_{0}^{n} S^1 + \sum_{1}^{n} S^2 + \sum_{2}^{n} S^3 + \sum_{3}^{n} S^4$$

where $\sum_{0}^{n} S^1 = S_0^1 + S_1^1 + S_2^1 + \ldots S_n^1$, etc.

Further on, **total output** is equal to

$$\sum_{3}^{n} O = (1 - r_4) \sum_{3}^{n} S^4$$

Grade-specific real inputs can be expressed as a function of repetition, promotion, and drop-out rates:

$$\underline{\text{1st grade}}: \sum_{0}^{n} S^1 = S_0^1 + r_1 S_0^1 + r_1^2 S_0^1 + \ldots r_1^n S_0^1$$

$$\text{and hence } \sum_{0}^{n} S^1 = \frac{1}{1-r_1} \cdot S_0^1$$

$$\underline{\text{2nd grade}}: \sum_{1}^{n} S^2 = p_1 S_0^1 + (p_1 S_1^1 + r_2 S_1^2) + (p_1 S_2^1 + r_2 S_2^2) + \ldots$$

$$\ldots (p_1 S_{n-1}^1 + r_2 S_{n-1}^2)$$

$$= p_1 (S_0^1 + S_1^1 + S_2^1 + \ldots S_{t-1}^1) + \ldots$$

$$\ldots r_2 (S_1^2 + S_2^2 + \ldots S_{n-1}^2)$$

$$= p_1 \sum_{0}^{n-1} S^1 + r_2 \sum_{1}^{n-1} S^2$$

$$\text{and hence } \sum_{1}^{n} S^2 = \frac{p_1}{(1 - r_1)(1 - r_2)} \cdot S_0^1$$

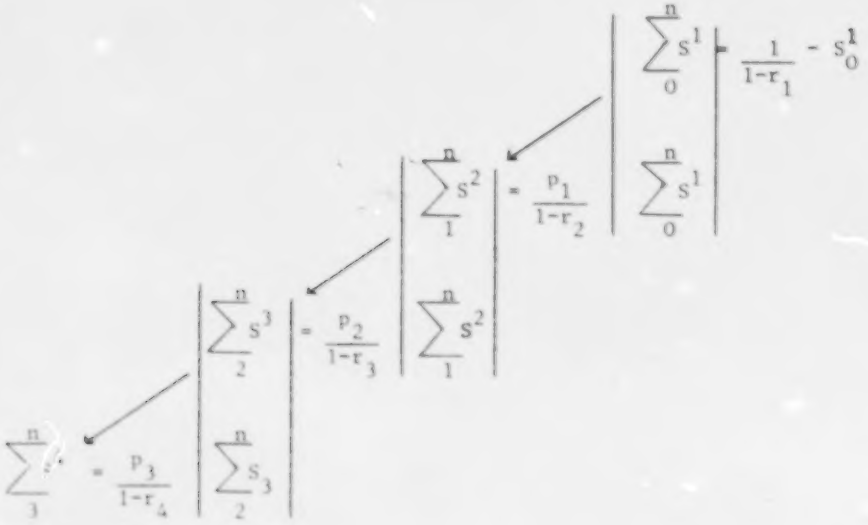
Using the same computational approach, we can calculate real inputs for grades 3 and 4:

$$\underline{\text{3rd grade}}: \sum_{2}^{n} S^3 = \frac{p_1 p_2}{(1 - r_1)(1 - r_2)(1 - r_3)} \cdot S_0^1$$

$$\underline{\text{4th grade}}: \sum_{3}^{n} S^4 = \frac{p_1 p_2 p_3}{(1 - r_1)(1 - r_2)(1 - r_3)(1 - r_4)} \cdot S_0^1$$

With the help of these formulae, the effect of any change in repetition and drop-out rates upon grade-specific or total real input can be studied.

Once that $\sum_{0}^{n} s^1$, i.e. total real input into grade 1, has been calculated, the subsequent inputs into grades 2, 3 and 4 may easily be derived:



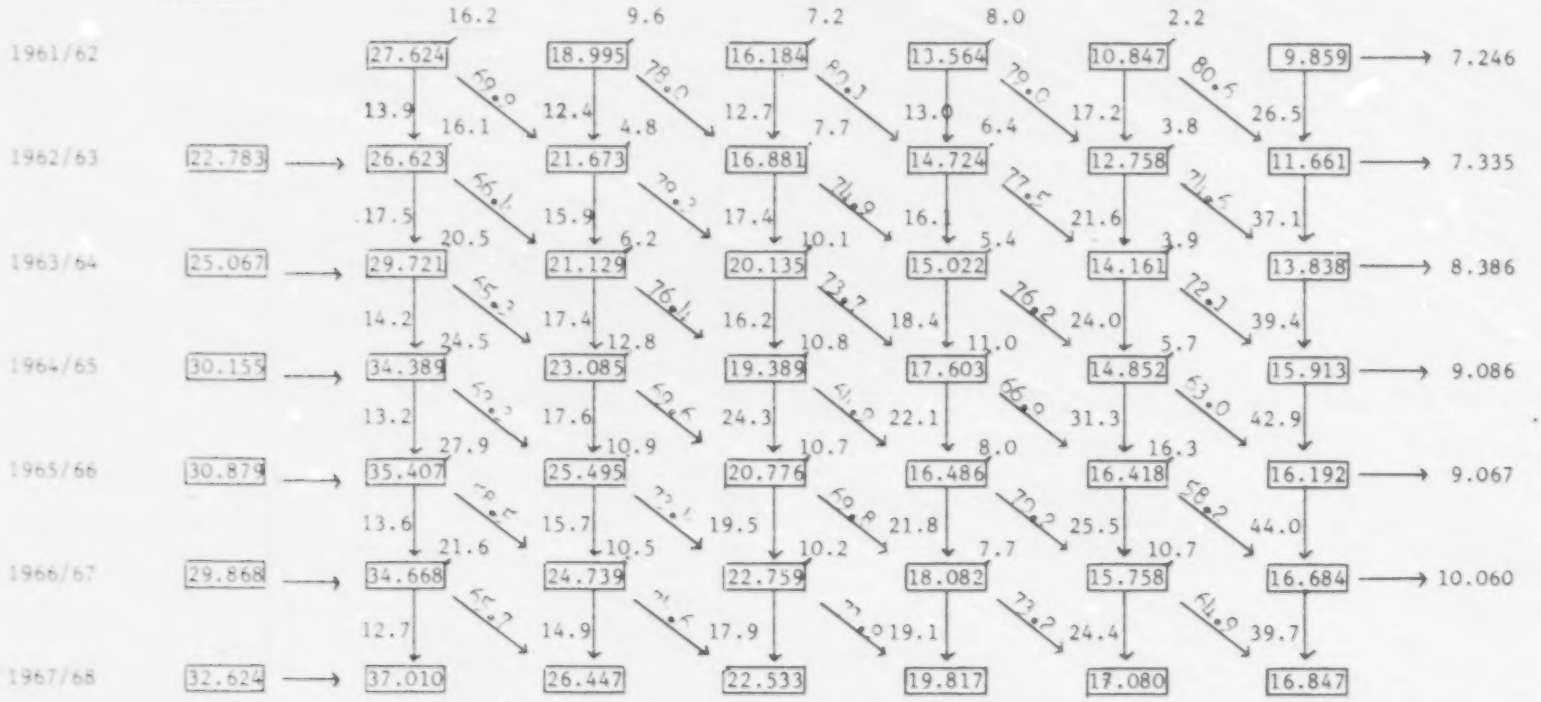
This very clear-cut mathematical pattern forms the basis of the various numerical simulations put forward in the present study.

A N N E X II

Patterns and Causes of Wastage at the Primary Level

Four Selected Countries

DAHOMEY : Actual flow of pupils through primary education, 1961/62 to 1967/68



1. The observed pattern

In Dahomey, wastage at the primary level appears to be primarily a problem of premature leaving. The heaviest drop-out occurs at the first grade; there, drop-out rates have risen from 16.2% in 1961/62 to 27.9% in 1965/66 and 21.6% in 1966/67. Repetition rates are by no means much higher than in many other developing countries. However, it must be noted that except for the first grade, these rates had a tendency to increase slightly in the period examined. At the terminal grade, repetition rates are considerably higher than for the preceding grades.

2. Some evidence as to causes

As regards repetition of the terminal grade, the low intake capacity of lower secondary education is likely to be the principal cause; however, a revision of examination standards at the terminal grade should also be taken into consideration. With respect to premature leaving of pupils, the following main causes are mentioned in Dahomey's reply to the UNESCO/IBE questionnaire:

- poor control of school attendance
- no instruction in indigenous language
- curriculum which is badly adapted to the actual aspiration of pupils
- considerable direct and indirect costs accruing to parents
- low school density in rural areas, lack of a school transport system.

The last-mentioned cause is indirectly supported by statistics showing that in 1965/66 the relative school enrolment of the age-group 6-13 varied from 51.3% to 13.0% between the six districts of the country.

A closer look at expenditure statistics demonstrates the trivial rôle of "social" and "material" expenditures within current expenditures on primary education:

Dahomey: Current expenditures on primary education, 1966

(1000 Francs CFA)

	total	of which (in %) personnel	material	social
public	966,270	89.0	10.2	0.8
private	255,441	89.6	10.2	0.2
total	1,221,711	89.1	10.2	0.7

Source: I.E.D.E.S.

In the public realm, only 0.8% of current expenditure in 1966 was spent on canteens, boarding schools, inspection, medical care, etc. (social expenditures), and only 10.2% on textbooks, school transport, etc. (material expenditures).

The bulk of current expenditure apparently went into teachers' remuneration, although statistics indicate a shortage in number and qualification rather than a satisfactory supply situation: Of the 3,188 primary teachers employed in 1966, only 58.5% were sufficiently qualified (Brevet or Certificat élémentaire d'aptitude pédagogique). Almost half of them, in other words, were likely to fall below the average annual salary:

Dahomey: Salary scale of primary school teachers, 1966

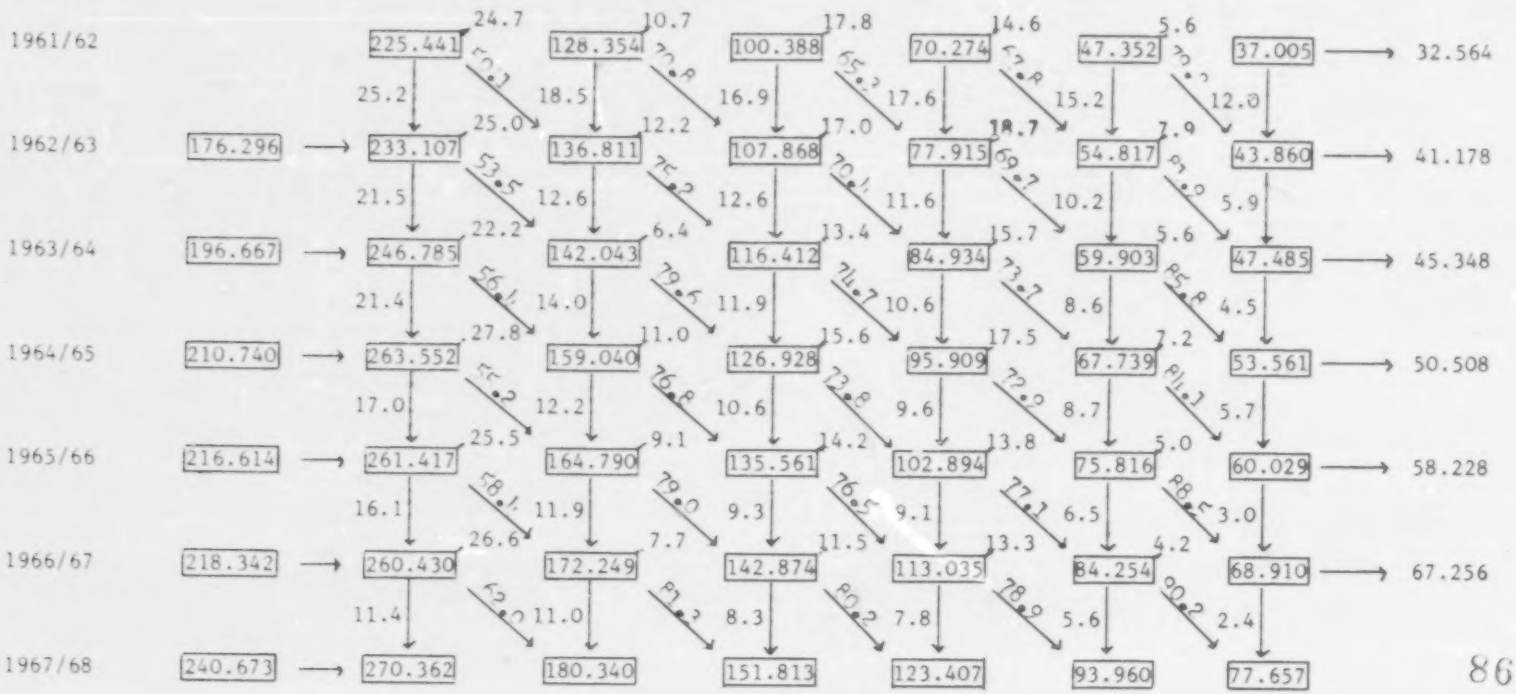
(1000 Francs CFA)

	average annual salary	salary range
public	432	197 - 770
private	181	113 - 490
total	335	...

Source: I.E.D.E.S.

At the same time, the average pupil-teacher-ratio was about 42,0, with 43,0 pupils per class. This figure, although certainly not higher than those of most neighbouring countries (Senegal 43,0, Niger 44,0, Mali 41,0, Ivory Coast 47,0), indicates a considerable undersupply of primary school teachers.

ECUADOR : Actual flow of pupils through primary education, 1961/62 to 1967/68



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1. The observed pattern

The flow-diagram shows that, from the outset, repetition rates have been comparatively low in Ecuador's primary education cycle. In 1961/62 they were 25.2% at the entrance grade and 12% to 18.5% at grades II to VI. Meanwhile, educational authorities have managed to lower the incidence of grade repetition continuously at all grades. In 1966/67, therefore, repetition rates were generally below 10%, the percentage getting smaller the farther a pupil proceeded through the cycle. The new organizational division into three sub-cycles of two years each will contribute to further reducing the repetition frequency, because promotion will be automatic within each sub-cycle.

On the other hand, drop-out rates are of considerable magnitude; this applies particularly to grade I, where nearly a quarter of all pupils used to drop out during recent years. Moreover, no improvements can be noted in this respect. Drop-out is not quite as high at the other grades, and the flow-diagram suggests slight ameliorations of the situation during the period examined. Yet, in 1966/67, some 11.5% and 13.3% of pupils in grades III and IV respectively left without completing the full cycle.

2. Some evidence as to causes

Most of the factors of educational wastage mentioned in Ecuador's reply to the UNESCO/IBE questionnaire are quite obviously and strongly connected with premature leaving of pupils.

There is, first of all, a cluster of factors indicative for a country with marked urban/rural differences in educational opportunities:

- frequent migrations of the rural population,
- seasonal child labour in rural areas,
- educational costs borne by parents are too high in relation to the low income level,
- language problems for certain ethnic groups,
- low school density in rural areas causes transport and accommodation problems.

The last-mentioned factor is highlighted by statistics showing the unequal distribution of day and evening primary schools between urban and rural zones:

Ecuador: Primary schools by type (1964/65)

	day schools	evening schools	total
urban	1,161	111	1,272
rural	5,214	-	5,214

Source: UNESCO mission report.

Shortage of teachers at the first grades is mentioned as another important cause of premature leaving; burdened with overcrowded classes, teachers make little effort to keep pupils in school. The overall pupil/teacher ratio for primary education does not picture this situation adequately; global ratios of 36.6% for urban, and [illegible] for rural zones seemingly imply a satisfactory supply of teachers (Source: UNESCO mission report. Ratios refer to 1964/65). However, actual supply

differentials become evident, if one looks at the distribution of primary schools by the number of teachers employed:

Ecuador: Primary schools by number of teachers (1964/65)

schools with	urban	%	rural	%
1 teacher	56	4.4	3 451	66.2
2 teachers	51	4.0	705	13.5
3 "	65	5.1	371	7.1
4 "	75	5.9	200	3.8
5 "	74	5.8	145	2.8
6 "	191	15.0	193	3.7
6 " and more	760	59.8	149	2.9
total	1 272	100.0	5 214	100.0

Source: UNESCO mission report.

In addition, the vast majority of primary schools in rural areas do not provide the full cycle of six grades, thereby forcing pupils either to move to another school or to withdraw from schooling:

Ecuador: Primary schools by number of grades provided, 1964/65 (urban/rural)

	urban	rural	total
only 1st grade	18	59	77
" 2nd "	26	318	344
" 3rd "	39	1 442	1 481
" 4th "	54	1 611	1 665
" 5th "	61	599	660
all 6 grades	1 074	1 185	2 259
total	1 272	5 214	6 486

Source: UNESCO mission report.

As practically half of the primary school population attends rural schools, the significance of this fact is crucial for the internal efficiency of the whole system.

With regard to grade repetition, maladaptation of programmes and curricula to actual needs, irregular attendance of pupils, and, finally, insufficient qualification of many primary school teachers are mentioned as crucial factors.

However, it appears that the percentage of unqualified teachers is relatively low in comparison with the alarming conditions in many other developing countries:

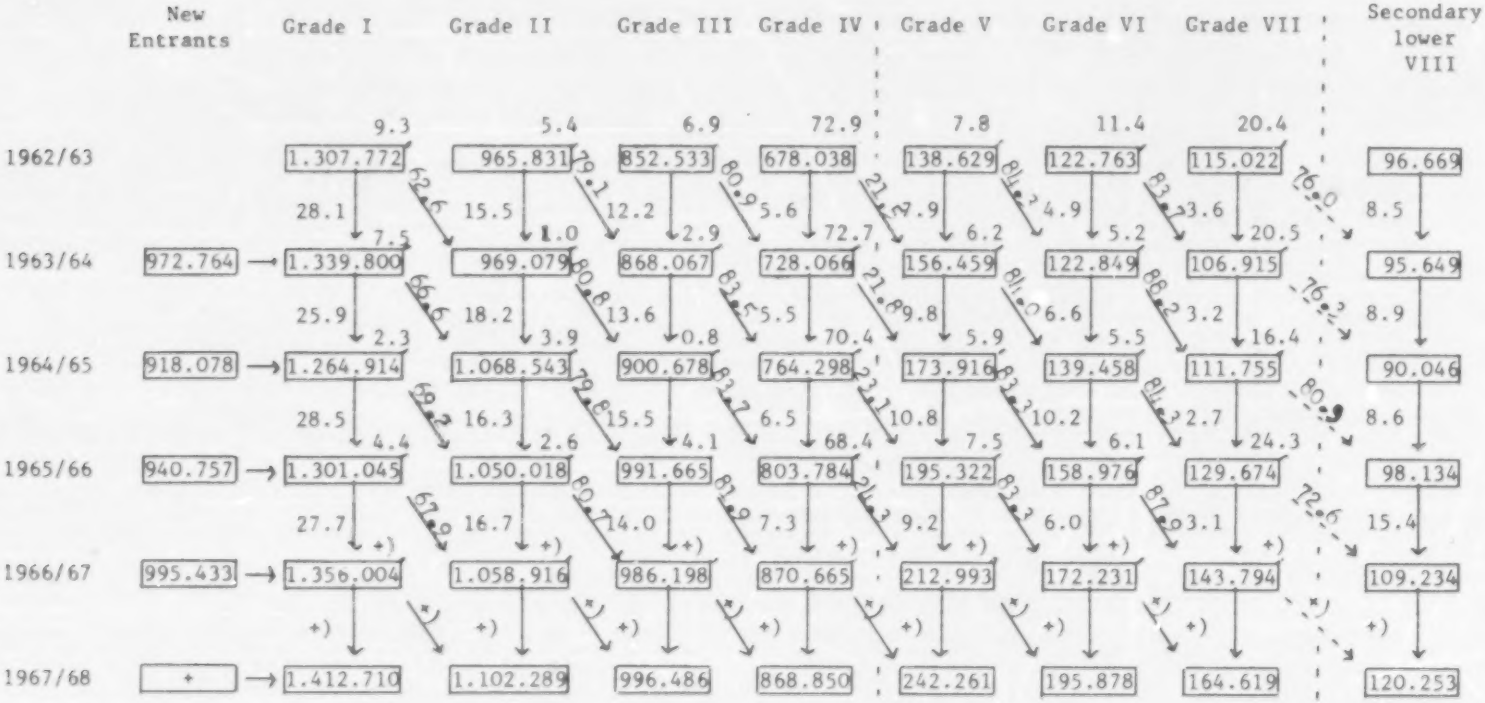
Ecuador: Primary school teachers by qualification 1964/65

	"normal" school teachers	teachers with university qualifications	teachers of specialized subjects	unqualified teachers	total
urban	5,867	2,066	693	1,643	10,269
rural	4,373	2,182	427	3,124	10,106
total	10,240	4,248	1,120	4,767	20,375

Source: UNESCO mission report.

In 1964/65, some 31% of primary school teachers in rural zones were completely unqualified, but the nation's average was not above 23.4%. The comparatively high percentage of qualified teachers apparently has contributed to keeping grade repetition rates within reasonable limits.

THAILAND : Actual flow of pupils through primary education (upper and lower), 1962/63 to 1967/68



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+) Data not yet available.

1. The observed pattern

A global look at the flow-diagram shows that in Thailand wastage in upper and lower primary education is not as marked as it is in many other developing countries. For a cohort starting in 1962/63, the wastage ratio is found to be W = 1,31 in the lower, and W = 1,14 in the upper cycle.

This rather favourable overall picture is, first of all, due to relatively low drop-out rates at all grades. The percentage of premature leaving has been slightly reduced between 1962/63 and 1966/67, so that not more than an average 5% dropped out in 1966/67 throughout grade I to grade VII. An exception is of course grade IV, the terminal grade of the lower cycle. Here, three out of four pupils leave the school, the rate of promotion to upper primary education being some 20.0% to 25.0% only. This suggests that there is a very distinct dividing line between the two sub-cycles of the primary education system, whereas upper primary and lower secondary education must be considered as a coherent cycle: At the end of grade VII, some 70.0% to 80.0% of the pupils proceed to the lower secondary cycle, and only about 20.0% leave school. This is true even though most secondary schools hold entrance examinations because of their limited intake capacity.

Repetition rates are somewhat more critical than the phenomenon of premature leaving. Notably, repetition is concentrated in the first grades: in 1962/63, 28.1% repeated grade I, 15.5% grade II and 12.2% grade III. No amelioration of this situation can be noted in subsequent years, although a semi-automatic promotion scheme with examinations every other year has reportedly been practised in an increasing number of primary schools.

2. Some evidence as to causes

The following main causes of drop-out are mentioned in Thailand's reply to the UNESCO/IBE questionnaire:

- lack of transportation in rural areas,
- low pay and lack of training of teachers,
- failure at first grades discouraging pupils from continuing,
- low income, poor motivation of parents, need of child labour,
- language problems in some parts of the country.

Taken together, these factors describe a causal syndrom which is typical for many rural societies; however, the different linguistic and cultural backgrounds of Thailand's southern provinces add a particular problem.

With respect to grade repetition, insufficient qualification of teachers turns out to be the crucial factor. The following table demonstrates that in spite of a remarkable upgrading of the qualification structure during recent years, the problem is still far from being solved:

Thailand: Primary teachers by qualification, 1960, 1965 and 1967

	1960	1965	1967
	%	%	%
total	100.0	100.0	100.0
of which teachers with:			
degree or diploma	0.2	7.5	9.7
secondary or elementary teacher's certificate	14.5	35.3	36.8
lower than elementary certificate	33.3	34.6	33.1
no certificate	52.0	22.6	20.4

Source: Thailand, Educational Statistics 1954-1960;
Thailand, School and Teacher Census, Final Reports, 1965 and 1967.

As repetition rates are particularly high at grades I to III, a mere redistribution of the most qualified teachers to these decisive grades might be a very promising measure.

The strong causal link between underqualification of teaching staff and failure of pupils is highlighted by a cross-section through six provinces, comparing the percentage of non-qualified teachers (A) with average repetition rates for grades I to IV (B) in 1964:

Province	A	rank	B	rank
Kalasin	16.8%	1	8.5%	3
Roi-Et	17.8%	2	5.5%	1
Ubon Ratchathani	19.4%	3	7.6%	2
Yala	24.2%	4	36.7%	4
Pattani	32.5%	5	37.7%	6
Narathiwal	33.4%	6	36.8%	5

Source: Thailand, School and Teacher Census, Final Report, 1965;
UNESCO Technical Seminar on Educational Wastage and School Dropouts, Bangkok 1966: Report of Thailand.

The rank order correlation between these two items is r = +0,78, which underlines the key role of well-qualified teachers in reducing failure and grade repetition of pupils.

An analysis of expenditures for primary education, notably their composition and development in time, throws some additional light on present shortcomings responsible for wastage in primary education:

Thailand: Expenditures of the Elementary and Adult Education Department, by purpose, 1960 - 1964

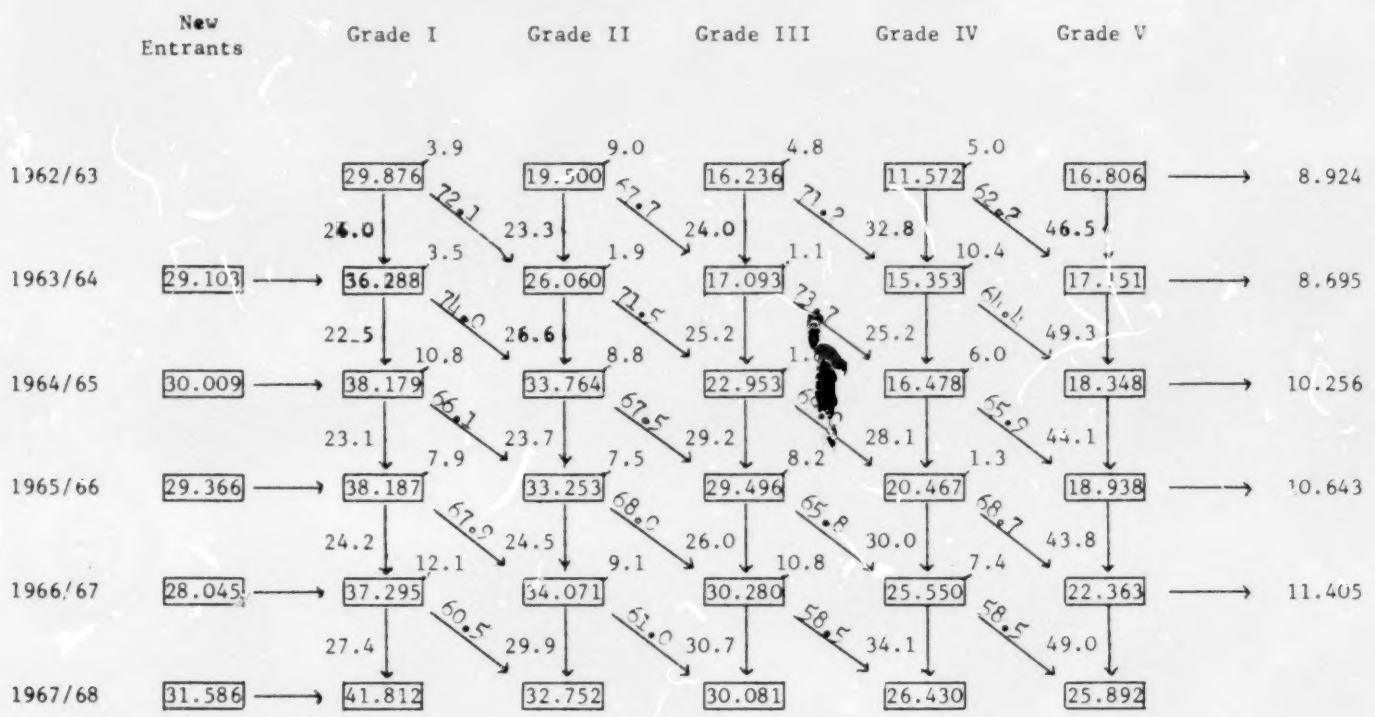
	1960	1961 +)	1962	1963	1964
total (000 baht)	821 500	888 000	945 500	1 019 950	1 121 500
of which (in %)					
salaries and wages	93.59%	90.69%	90.43%	88.20%	87.57%
repairs, maintenance, etc.	0.86%	0.89%	1.05%	1.36%	1.04%
supplies and materials	2.15%	1.69%	1.50%	0.15%	1.31%
land and structures	2.80%	5.59%	5.59%	7.25%	7.98%
equipment	0.27%	0.51%	0.61%	0.73%	0.82%
printing and reproduction of books	-	0.10%	0.08%	0.08%	0.23%
subsidies for students	0.25%	0.23%	0.22%	0.21%	0.21%
other	0.58%	0.30%	0.52%	2.02%	0.84%

+) Estimated

Source: Thailand, Ministry of Education, Educat. Planning Office: Analysis of the Ministry of Education Budget, 1960 - 1964.

One notes, first of all, that the share of teachers' salaries and wages diminishes between 1960 and 1964, although more teachers, both absolutely and in relation to the growing school population, were employed. This observation suggests that the increase in qualification and, as a corollary, the necessary higher pay of teachers have not fully kept pace with the development. The table also points to the insufficient production and distribution of textbooks - a factor mentioned in Thailand's reply to the UNESCO/IBE questionnaire; expenditures on this item were almost negligible during the period examined. The same applies to expenditures on supplies, teaching materials, and equipment.

MALI : Actual flow of pupils through primary education, 1962/63 to 1967/68



1. The observed pattern

In Mali, grade repetition is the dominant form of educational wastage at the primary level. Repetition rates are extremely high at grade V, where they have been fluctuating between 44% and 49% during recent years. The problem has not been quite as alarming for the other grades, but there, too, repetition rates show a slightly increasing tendency during the years 1962/63 to 1967/68. Consequently, more than 30% of pupils in grades III and IV repeated in 1966/67.

As a rule, drop-out rates have been below 10% at all grades and for the whole observation period. There are strong fluctuations of that rate between successive years, but this phenomenon may to some extent be due to unreliable data. It is only at the entrance grade, that a distinct overall increase of drop-out rates during the period examined can be noted.

2. Some evidence as to causes

Mali's reply to the UNESCO/IBE questionnaire points out the following major causes of premature leaving at the primary level:

- insufficient facilities for boarding and accommodation of pupils in rural areas,
- nomadism,
- premature marriage of girls.

As regards expenditure on school-meals, other boarding costs, school clothing, etc., not more than 3% of public current expenditure on primary education was devoted to these purposes in the 1965/66 educational budget:

Mali: Current expenditure on primary education, 1965/66

(000 Francs CFA)

	total	of which (in %)		
		personnel	material	social
public	1 274 159	78.6	18.4	3.0
private	82 978	81.7	18.3	-
total	1 357 137	78.8	18.4	2.8

Source: I.E.D.E.S.

On the other hand, "material" expenditures, including expenditures on textbooks, transport facilities, etc., accounted for not less than 18.4% of current expenditure, leaving another 78.8% for teachers' remuneration.

The salary scale of primary teachers is very wide, thereby pointing to considerable differences in qualification.

Mali: Salary scale of primary school teachers, 1965/66

(000 Francs CFA)

	average annual salary	salary range
public	351	216 - 949
private	273	202 - 895
total	345	...

Source: I.E.D.E.S.

The average annual salary was 345,000 Francs CFA in 1965/66, while that of a regular "instituteur adjoint" amounted to 498,000 Francs CFA.

In fact, out of 3,100 primary teachers employed in the public sector in 1965/66, only 52.1% had a "Diplôme d'enseignement fondamental" or a better qualification. Lack of teachers' qualification is therefore mentioned in Mali's reply to the UNESCO/IBE questionnaire as one of the most important causes of low attainment and repetition of primary pupils. Insufficient pedagogical training of teachers is added as a particularly grave issue.

The importance of this factor for failure or success of pupils comes into evidence, if cohort retention rates are correlated with a teachers' qualification-index over the 10 districts of the country: in spite of various data deficiencies biasing the exercise, one arrives at a positive rank order correlation coefficient of r = +0,38 (Source: République du Mali, Ministère de l'Education nationale et de la jeunesse et des sports: Problèmes du Rendement de l'Enseignement Fondamental; unpublished, June 1967). Raising the percentage of qualified primary teachers appears to be the key to lowering repetition and reducing educational wastage in Mali.